

# **Near- and Far-Field Analysis**

## **Technical Report**

**Near- and Far-Field Ambient Air Quality  
Technical Report  
for the  
Desolation Flats Natural Gas Exploration and  
Development Project**

Prepared for:

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## **1.0 INTRODUCTION**

The U.S. Department of the Interior (DOI), Bureau of Land Management (BLM), has prepared an Environmental Impact Statement (EIS) to evaluate and disclose to the public direct, indirect and cumulative environmental impacts resulting from continued exploration for and development of natural gas resources for the Desolation Flats Natural Gas Exploration and Development Project (the “Project”) located in Sweetwater and Carbon Counties, Wyoming. This document provides a detailed description of the procedures used and results obtained for modeling of the potential cumulative ambient air quality and air quality related values (AQRV) impacts due to the Project and other sources within the near-field (less than 50 km) and far-field (50 km to over 350 km) domains.

This Near- and Far-Field Air Quality Technical Report is one of three documents that support the ambient air quality impact analysis in the EIS. The remaining two documents are:

- Emissions Inventory for the Desolation Flats Natural Gas Exploration and Development Project (Buys and Associates, 2001)
- Sub-Grid Ambient Air Quality Technical Report for the Desolation Flats Natural Gas Exploration and Development Project (Buys and Associates, 2001)

### **1.1 Overview of Approach**

Ambient air quality impacts of the Desolation Flats Project were assessed for three different distance scales: sub-grid (less than 4 km), near-field (4 km to 50 km) and far-field (greater than 50 km). The far-field analysis is focused on cumulative impacts on sensitive receptors (i.e., Class I areas) and the sub-grid analysis is focused on impacts very near project sources. The near-field analysis is focused on ensuring that there are no isolated impacts within 50 km of the Project that could be significantly greater than the sub-grid impacts.

In order to analyze the sub-grid impacts, the Industrial Source Complex (ISCST3) model was used. To assess the near-field and far-field impacts the CALPUFF set of models was used. The CALPUFF set of models (CALMET, CALPUFF, CALPOST, and associated utilities) are designed specifically to assess ambient air quality impacts at significant distances (and therefore long pollutant travel times) from the source. For this analysis, CALMET Version 5.2, Level 000602a; CALPUFF Version 5.4, Level 000602-1; and CALPOST Version 5.2, Level 991104b were used.

The CALPUFF set of models were run for calendar year 1995 and included cumulative impacts from the Desolation Flats Project sources, permitted sources, and sources associated with reasonably foreseeable development within the model domain. In addition, the modeled impacts were combined with measured background ambient air quality as of 1995 so that the cumulative impact of all existing and reasonably foreseeable emission sources were evaluated. The modeled ambient concentrations of criteria pollutants were compared to the National, Wyoming, and Colorado Ambient Air Quality Standards (NAAQS, WAAQS, CAAQS) and (for informational purposes only) to the Prevention of Significant Deterioration (PSD) Class I and II increments. In addition, the model concentration and deposition outputs were processed to evaluate visibility and acid deposition impacts at sensitive areas for comparison with the Federal Land Manager (FLM) Limit of Acceptable Change (LAC) thresholds.

## **1.2 Report Organization**

This Near- and Far-Field ambient air quality impact analysis follows the procedures established in the Draft Air Quality Assessment Protocol for the Desolation Flats Natural Gas Development Project, dated October 20, 2000 (Buys and Associates, 2000). Section 2 of this report describes the meteorological modeling (CALMET), Section 3 discusses the source and emission inventory modeled, while Chapter 4 discusses the CALPUFF dispersion modeling. Section 5 discusses how the CALPUFF model results were processed (CALPOST) in order to obtain results of interest, and Section 6 presents the results of the CALPOST processing, including AQRV analyses.

## **2.0 CALMET MODELING**

### **2.1 Model Domain**

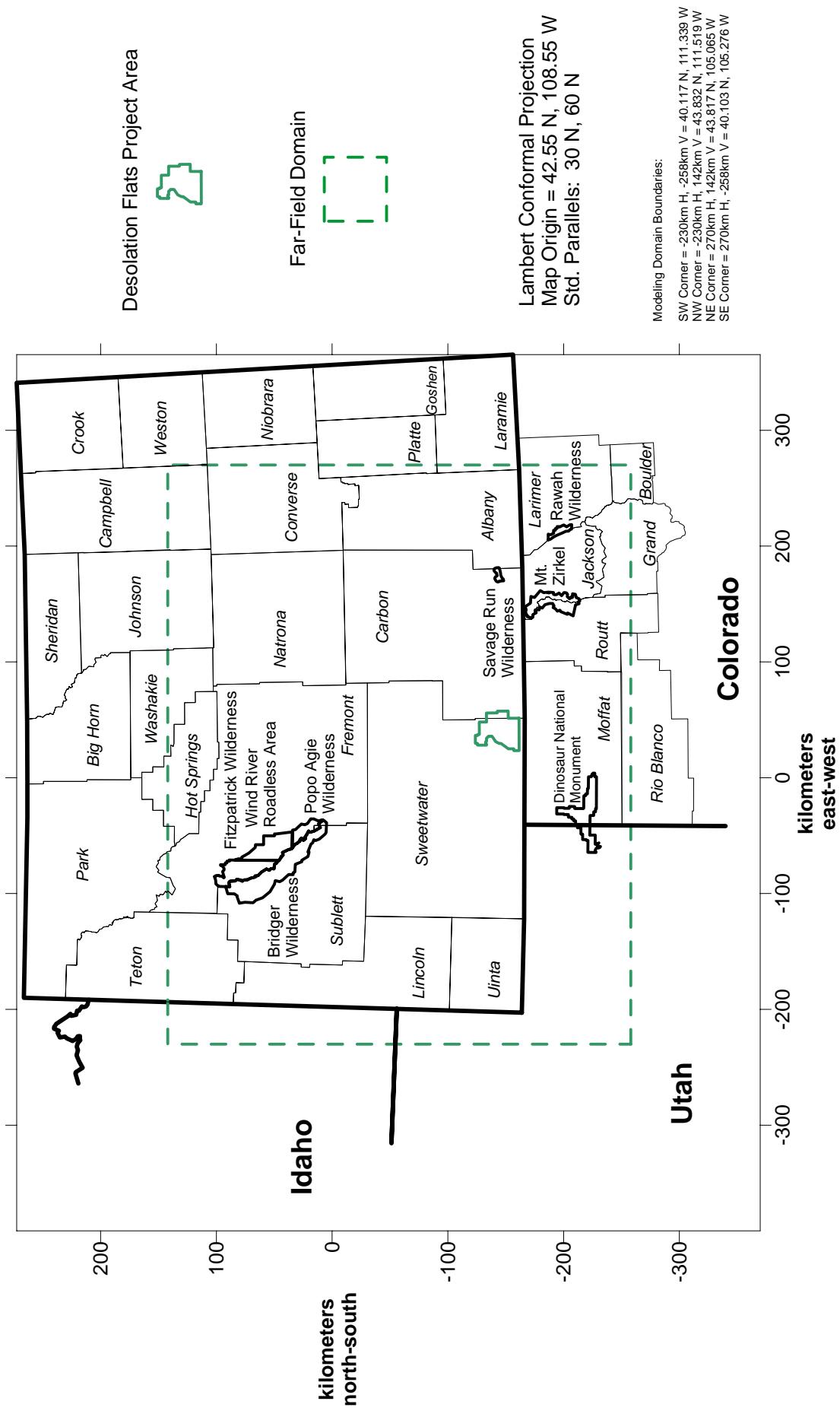
The first step in CALPUFF analysis is setting up the model domain and performing the meteorological modeling. For this study, the model domain used in the Continental Divide/Wamsutter II and South Baggs (CD/WII/SB) Environmental Impact Statements (BLM, 1999) was used. This domain is presented in Figure 2-1 and includes southwest Wyoming, southeastern Idaho, northeastern Utah, and northwestern Colorado. The modeling domain is 500 km east-west and 400 km north-south and includes eight sensitive areas. The domain is based on a Lambert Conformal Projection (LCP), with a central longitude/latitude at (108.55° West, 42.55° North) and first and second standard latitude parallels at 30° and 60°.

### **2.2 Meteorological Modeling**

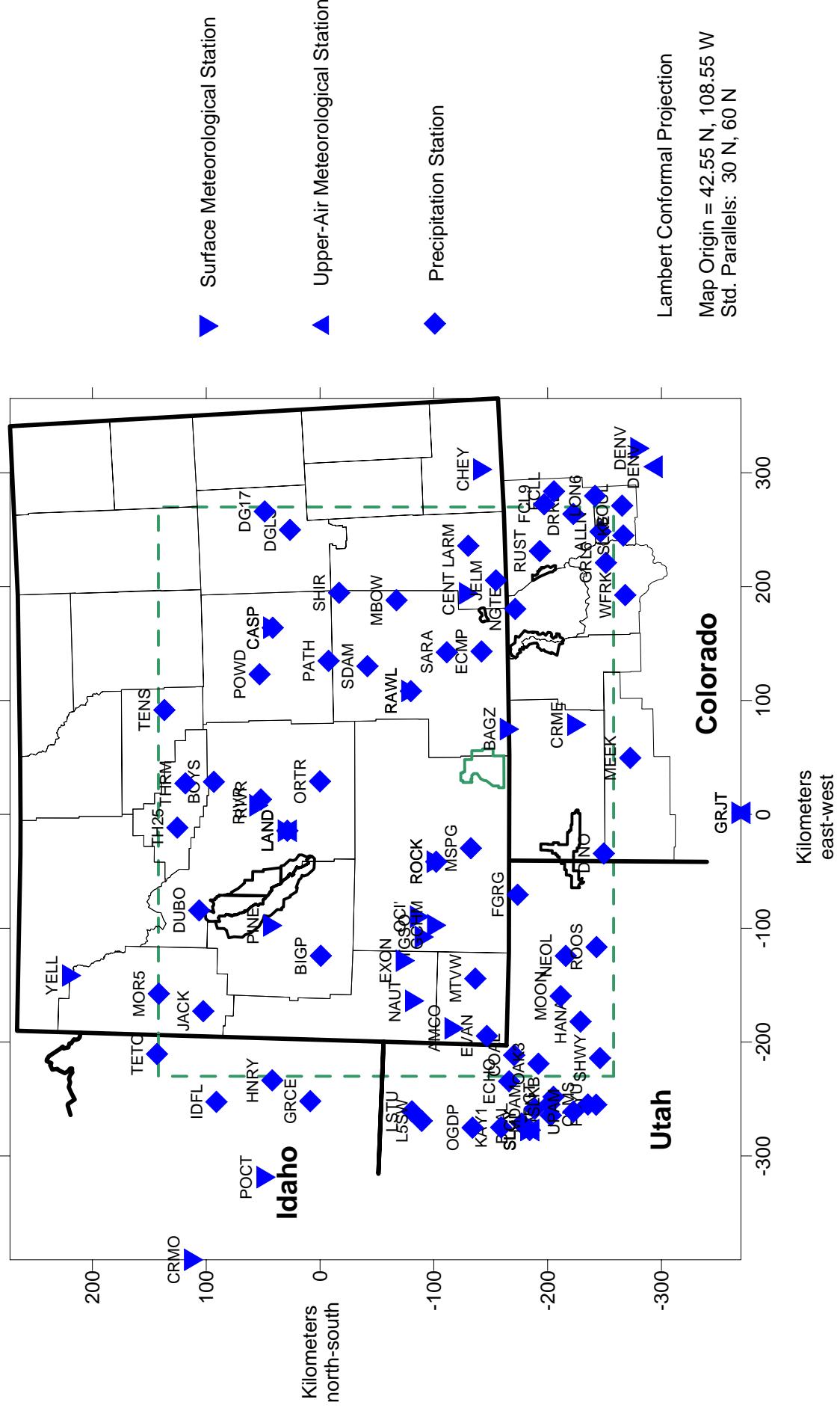
CALMET includes a diagnostic wind model (Douglas and Kessler, 1990) which combines surface and upper-air meteorological data with diagnostic effects of terrain and other factors to generate three-dimensional wind fields. CALMET also includes other interpolation algorithms to generate three-dimensional temperature, pressure, stability, and other meteorological variables and two-dimensional precipitation fields. The CALMET modeling (and subsequent CALPUFF modeling) was performed on a 4 km grid (125 grid cells east-west and 100 grid cells north-south). Since there are only a limited number of meteorological stations available in the 20,000 square km model domain and since there is considerable complex terrain in the area, before the CALMET diagnostic model was run, a coarse grid (20-km) resolution simulation of the MM5 prognostic meteorological model was used as input into CALMET to define the synoptic-scale flow features. The CALMET diagnostic wind algorithms and local observations were then used to better characterize the local wind variations at 4-km resolution. The MM5 input was the same MM5 input used in the CD/WII/SB EIS. The MM5 simulation is a four dimensional data assimilation (FDDA) and interpolation of the standard National Weather Service (NWS) upper-air meteorological stations. Upper-air data from an area 680 km by 680 km approximately centered on the modeling domain were used for the MM5 simulation. More details are provided in the CD/WII/SB Air Quality Impact Assessment Technical Support Document for Far-Field Analysis project (BLM 1999).

The MM5 data are then combined with the surface data within the modeling domain in order to generate the 4-km resolution wind fields and precipitation data needed by CALPUFF. Again, the CD/WII/SB surface meteorological data were used for the Desolation Flats CALMET modeling. There were 22 surface meteorological, four upper-air meteorological and 67 precipitation stations within the model domain. These stations are presented in Figure 2-2. The CD/WII/SB study used 14 sets of surface data covering January through May, June 1-13, June 14-30, July through September, October 1-18, October 19-30, November, and December. (The months of June and October were split because one of the meteorological stations, South Baggs, had a significant amount of missing data in June and October). Therefore, the CALMET model was run 14 times, once for each of the data periods.

## Figure 2-1 Modeling Domain



**Figure 2-2**  
**Surface, Upper-Air and Precipitation Stations**



The terrain and land use data required by CALMET were the same data used in the CD/WII/SB air quality study. The terrain data were derived from 3-arc second (approximately 90-meter spacing) digital elevation model (DEM) produced by the United States Geological Survey (USGS). Since the CALMET and CALPUFF modeling domain was based on 4 km spacing, the terrain elevation at each 4 km grid cell was calculated by averaging all of the 90-meter data within the 4 km cell. A similar procedure was applied to the USGS land use category data. The CD/WII/SB air quality analysis included sensitivity analyses to confirm that no significant terrain features were lost due to the 4-km grid averaging. Figure 2-3 presents the terrain for the model domain.

The land use data used in the CALMET modeling were the same data used in the CD/WII/SB EIS. The land used data were derived from USGS Composite Theme Grid (CTG) data that are provided with a resolution of 200 meters. However, the USGS land use data include 38 different categories, while the CALMET model only uses 14 categories. Therefore, CD/WII/SB developed a cross-reference to the USGS land use categories as shown in Table 2-1. The USGS 200-meter grid data were then overlain on the CALMET 4-km by 4-km grid, and the most predominate land use type selected to represent land use for the 4 km cell. Table 2-1 summarize the CALMET default land use categories. Figure 2-4 presents the terrain along with the USGS land use categories for the modeling domain.

The MM5 meteorological simulation, the surface meteorological data (including precipitation), the terrain data, and the land use data were then all input into the CALMET model. The CALMET model contains a number of options that must be selected or de-selected through the CALMET input control file. An example of the CALMET control file used for the January CALMET model is presented in Exhibit 2-1 located at the end of Section 2.0.

As a quality assurance check of the input data and CALMET model, wind fields on selected days were analyzed and visually compared to terrain features. The results of this analysis, an example of which is shown in Figure 2-5 indicate that the CALMET model appears to represent the wind fields that one would expect based on the synoptic-scale meteorological features and local scale land use and terrain features. The CALMET model was run for each month of meteorological data and then used in the CALPUFF model runs.

**Figure 2-3**  
**Terrain in Model Domain**

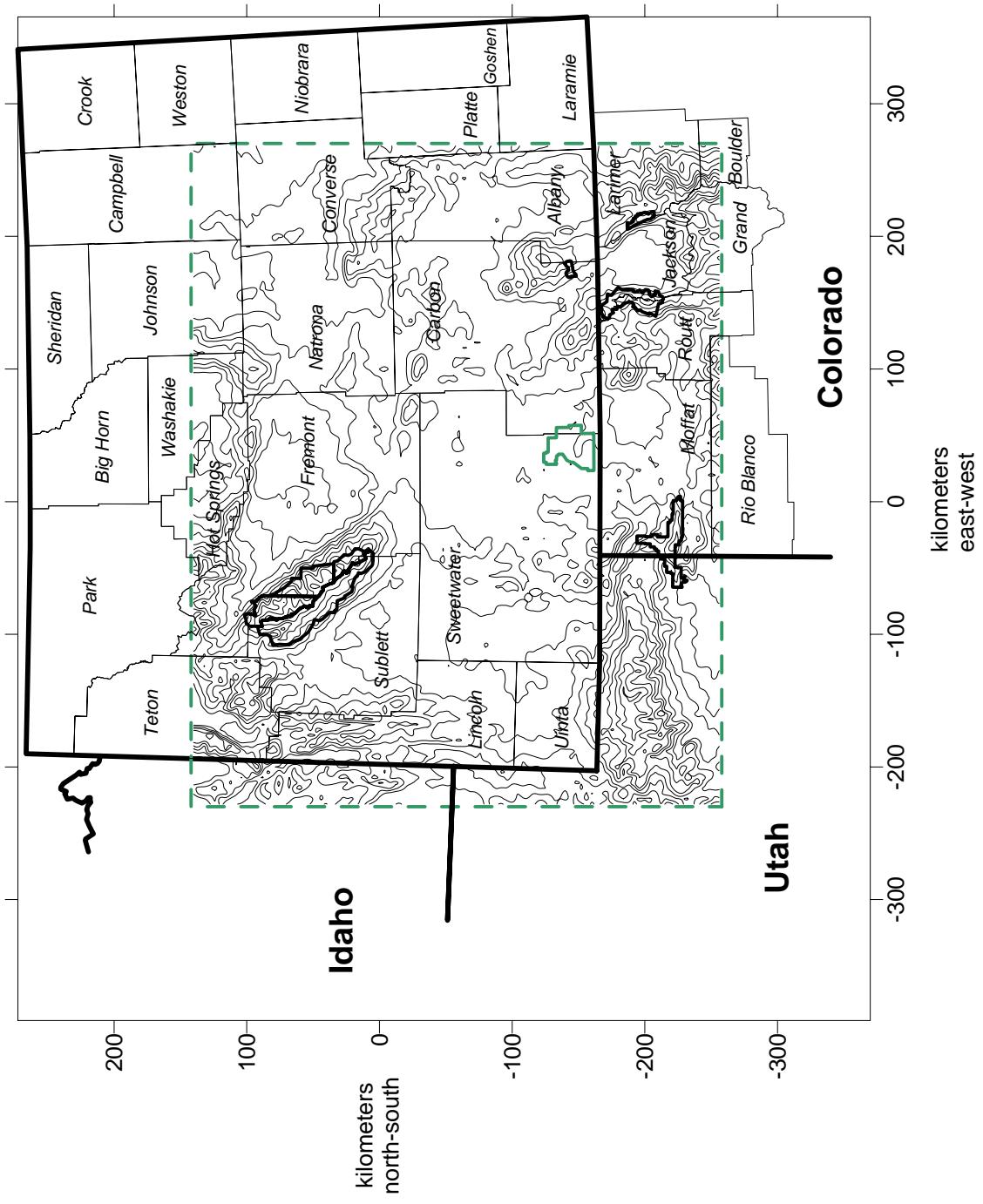
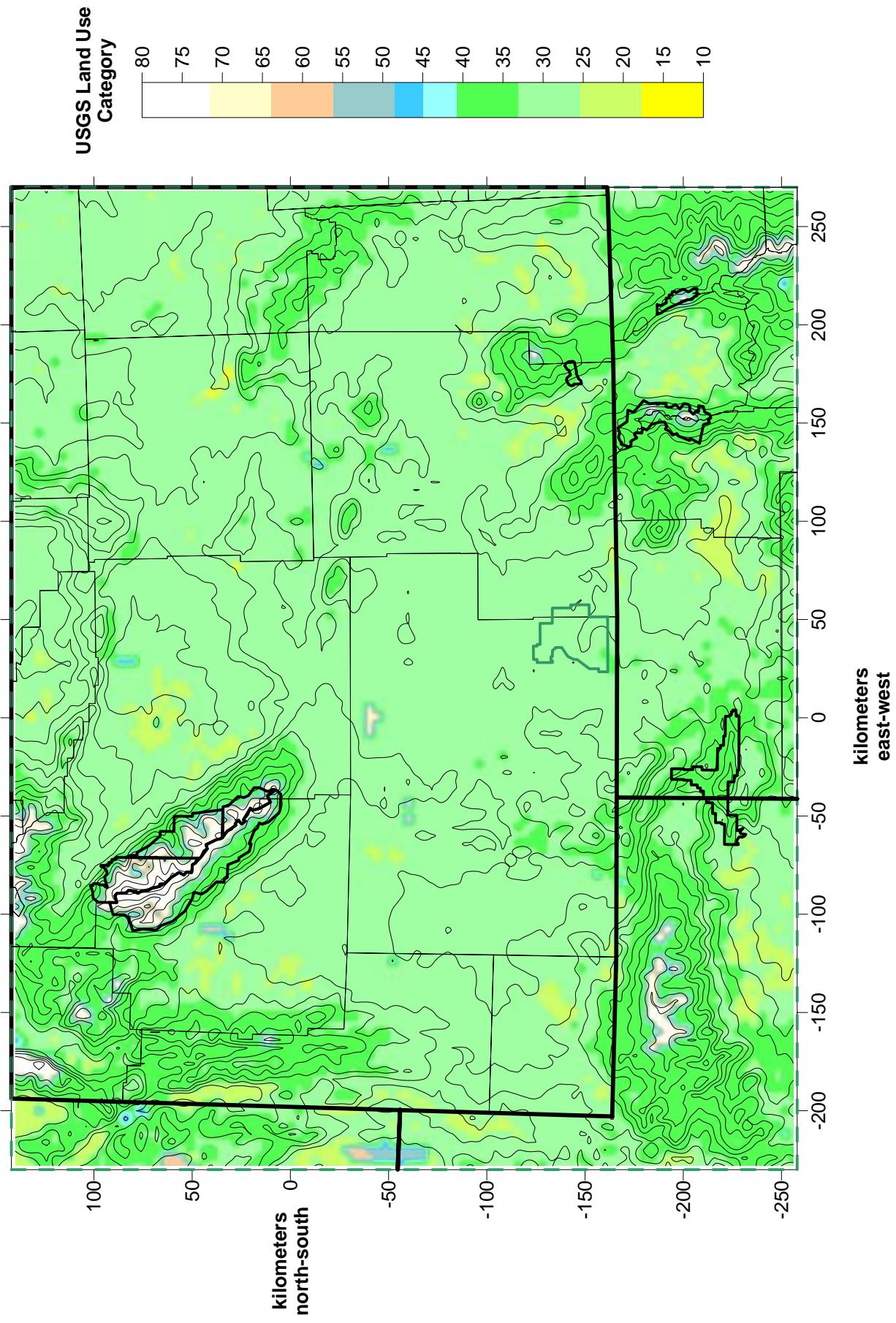


Table 2-1 Default CALMET Land Use Categories and Associated Geophysical Parameters Based on the U.S. Geological Survey Land Use Classification System (Scire et al, 1998).

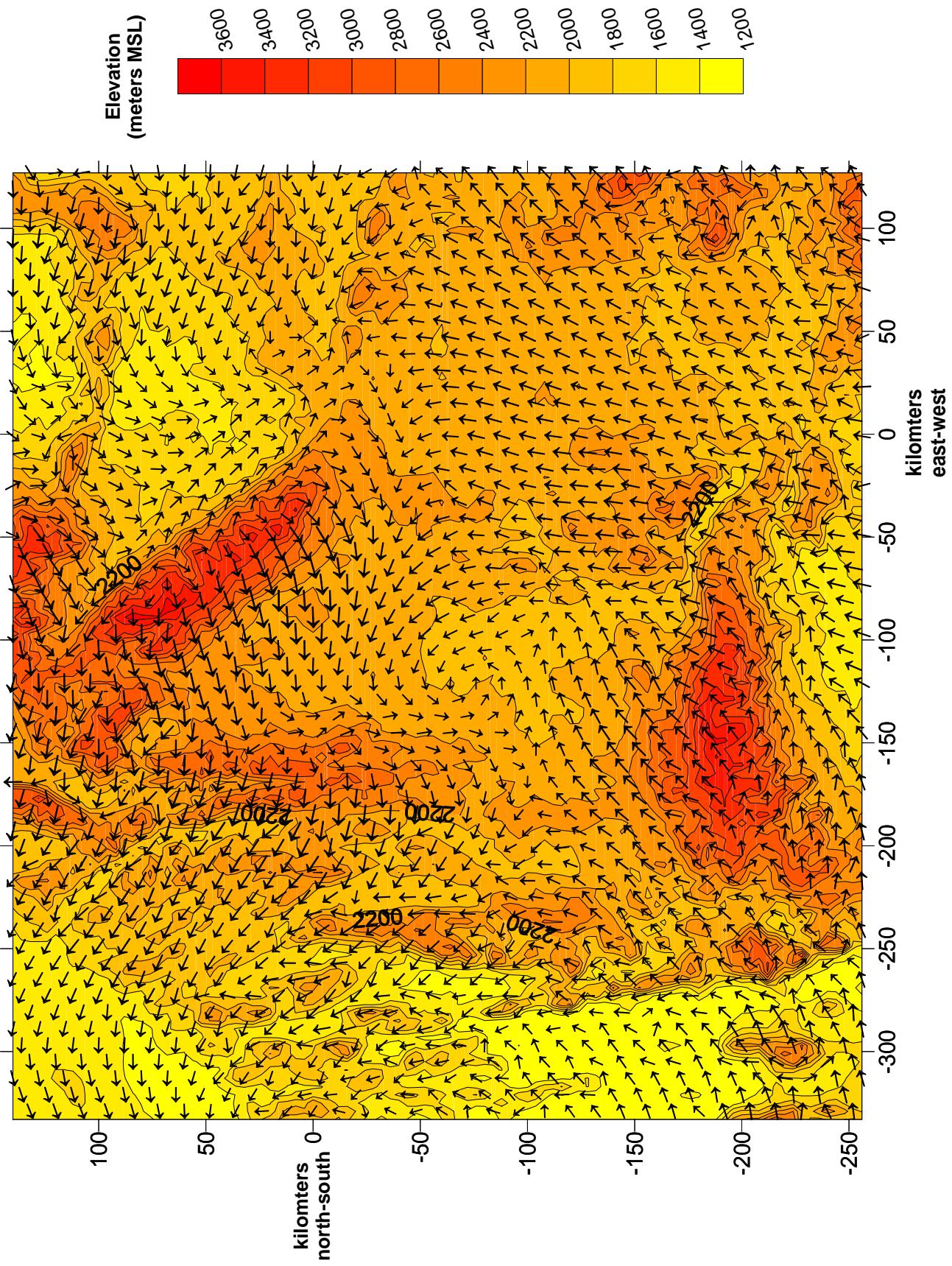
Land Use Category	Description	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux Parameter	Anthropogenic Heat Flux (W/m <sup>2</sup> )	Leaf Area Index
10	Urban or built-up land	1.0	0.18	1.5	.25	0.0	0.2
20	Agricultural land - unirrigated	0.25	0.15	1.0	.15	0.0	3.0
-20*	Agricultural land - irrigated	0.25	0.15	0.5	.15	0.0	3.0
30	Rangeland	0.05	0.25	1.0	.15	0.0	0.5
40	Forest land	1.0	0.10	1.0	.15	0.0	7.0
50	Water	0.001	0.10	0.0	1.0	0.0	0.0
51	Small water body	0.001	0.10	0.0	1.0	0.0	0.0
55	Large water body	0.001	0.10	0.0	1.0	0.0	0.0
60	Wetland	1.0	0.10	0.5	.25	0.0	2.0
61	Forested wetland	1.0	0.1	0.5	0.25	0.0	2.0
62	Non-forested wetland	0.2	0.1	0.1	0.25	0.0	1.0
70	Barren land	0.05	0.30	1.0	.15	0.0	0.05
80	Tundra	.20	0.30	0.5	.15	0.0	0.0
90	Perennial snow or ice	.20	.70	0.5	.15	0.0	0.0

NOTE: \* Negative values indicate "irrigated" land use

**Figure 2-4**  
**Land Use and Terrain in Model Domain**



**Figure 2-5**  
**Wind Field on August 19, 1995, Hour 2200**  
**for Northwest Quadrant of Modeling Domain**



## Exhibit 2-1 Example CALMET Control File

DESOLATION FLATS EIS  
4 KM GRID RESOLUTION -- 125 x 100 grid cells (500 km x 400 km domain)  
JANUARY 1-31, 1995  
----- Run title (3 lines) -----

### CALMET MODEL CONTROL FILE

-----  
INPUT GROUP: 0 -- Input and Output File Names

#### Subgroup (a)

-----  
Default Name Type File Name  
-----  
GEO.DAT input ! GEODAT=D:\DesFlats\CALMET\GEO4KM.DAT !  
SURF.DAT input ! SRFDAT=D:\DesFlats\CALMET\SURF.DAT !  
CLOUD.DAT input \* CLDDAT= \*  
PRECIP.DAT input ! PRCDAT=D:\DesFlats\CALMET\PRECIP.DAT !  
MM4.DAT input ! MM4DAT=D:\DesFlats\CALMET\MM4\_9501.DAT !  
WT.DAT input \* WTDAT= \*  
  
CALMET.LST output ! METLST=D:\DesFlats\CALMET\CALMET01.LST !  
CALMET.DAT output ! METDAT=D:\DesFlats\CALMET\CALMET01.DAT !  
PACOUT.DAT output \* PACDAT= \*

All file names will be converted to lower case if LCFILES = T  
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE  
T = lower case ! LCFILES = T !  
F = UPPER CASE

#### NUMBER OF UPPER AIR & OVERWATER STATIONS:

Number of upper air stations (NUSTA) No default ! NUSTA = 4 !  
Number of overwater met stations  
(NOWSTA) No default ! NOWSTA = 0 !

!END!

#### Subgroup (b)

-----  
Upper air files (one per station)

-----  
Default Name Type File Name  
-----  
UP1.DAT input 1 ! UPDAT=D:\DesFlats\CALMET\UA95DEN.DAT! !END!  
UP2.DAT input 2 ! UPDAT=D:\DesFlats\CALMET\UA95GJT.DAT! !END!  
UP3.DAT input 3 ! UPDAT=D:\DesFlats\CALMET\UA95LND.DAT! !END!  
UP4.DAT input 4 ! UPDAT=D:\DesFlats\CALMET\UA95SLC.DAT! !END!

#### Subgroup (c)

-----  
Overwater station files (one per station)

Default Name Type File Name  
----- -----  
-----

Subgroup (d)  
-----

Other file names  
-----

Default Name Type File Name  
----- -----  
DIAG.DAT input \* DIADAT= \*  
PROG.DAT input \* PRGDAT= \*  
  
TEST.PRT output ! TSTPRT= TEST.PRT !  
TEST.OUT output ! TSTOUT= TEST.OUT !  
TEST.KIN output ! TSTKIN= TEST.KIN !  
TEST.FRД output ! TSTFRD= TEST.FRД !  
TEST.SLP output ! TSTS LP= TEST.SLP !

-----  
NOTES: (1) File/path names can be up to 70 characters in length  
(2) Subgroups (a) and (d) must have ONE 'END' (surround by  
delimiters) at the end of the group  
(3) Subgroups (b) and (c) must have an 'END' (surround by  
delimiters) at the end of EACH LINE

!END!

-----  
INPUT GROUP: 1 -- General run control parameters  
-----

Starting date: Year (IBYR) -- No default ! IBYR= 1995 !  
Month (IBMO) -- No default ! IBMO= 1 !  
Day (IBDY) -- No default ! IBDY= 1 !  
Hour (IBHR) -- No default ! IBHR= 0 !

Base time zone (IBTZ) -- No default ! IBTZ= 7 !  
PST = 08, MST = 07  
CST = 06, EST = 05

Length of run (hours) (IRLG) -- No default ! IRLG= 744 !

Run type (IRTYPE) -- Default: 1 ! IRTYPE= 1 !

0 = Computes wind fields only  
1 = Computes wind fields and micrometeorological variables  
(u\*, w\*, L, z, etc.)  
(IRTYPE must be 1 to run CALPUFF or CALGRID)

Compute special data fields required  
by CALGRID (i.e., 3-D fields of W wind  
components and temperature)  
in addition to regular Default: T ! LCALGRD = T !  
fields ? (LCALGRD)

(LCALGRD must be T to run CALGRID)

Flag to stop run after  
SETUP phase (ITEST) Default: 2 ! ITEST= 2 !  
(Used to allow checking  
of the model inputs, files, etc.)  
ITEST = 1 - STOPS program after SETUP phase  
ITEST = 2 - Continues with execution of  
COMPUTATIONAL phase after SETUP

!END!

-----  
INPUT GROUP: 2 -- Grid control parameters  
-----

#### HORIZONTAL GRID DEFINITION:

No. X grid cells (NX) No default ! NX = 125 !  
No. Y grid cells (NY) No default ! NY = 100 !

GRID SPACING (DGRIDKM) No default ! DGRIDKM = 4. !  
Units: km

REFERENCE COORDINATES  
of SOUTHWEST corner of grid cell (1,1)

X coordinate (XORIGKM) No default ! XORIGKM = -230.000 !  
Y coordinate (YORIGKM) No default ! YORIGKM = -258.000 !  
Units: km  
Latitude (XLAT0) No default ! XLAT0 = 40.117 !  
Longitude (XLON0) No default ! XLON0 = 111.339 !

UTM ZONE (IUTMZN) Default: 0 ! IUTMZN = 12 !

#### LAMBERT CONFORMAL PARAMETERS

Rotate input winds from true north to  
map north using a Lambert conformal  
projection? (LLCONF) Default: F ! LLCONF = T !

Latitude of 1st standard parallel Default: 30. ! XLAT1 = 30.000 !  
Latitude of 2nd standard parallel Default: 60. ! XLAT2 = 60.000 !  
(XLAT1 and XLAT2; + in NH, - in SH)

Longitude (RLON0) Default = 90. ! RLON0 = 108.550 !  
(used only if LLCONF = T)  
(Positive = W. Hemisphere;  
Negative = E. Hemisphere)  
Origin Latitude (RLAT0) Default = 40. ! RLAT0 = 42.550 !  
(used only if IPROG > 2)  
(Positive = N. Hemisphere;  
Negative = S. Hemisphere)

Vertical grid definition:

No. of vertical layers (NZ) No default ! NZ = 10 !

Cell face heights in arbitrary  
vertical grid (ZFACE(NZ+1)) No defaults  
Units: m  
! ZFACE = 0.,20.,40.,80.,160.,300.,600.,1000.,1500.,2200.,3000. !

!END!

---

INPUT GROUP: 3 -- Output Options

---

#### DISK OUTPUT OPTION

Save met. fields in an unformatted  
output file ? (LSAVE) Default: T ! LSAVE = T !  
(F = Do not save, T = Save)

Type of unformatted output file:  
(IFORMO) Default: 1 ! IFORMO = 1 !

1 = CALPUFF/CALGRID type file (CALMET.DAT)  
2 = MESOPUFF-II type file (PACOUT.DAT)

#### LINE PRINTER OUTPUT OPTIONS:

Print met. fields ? (LPRINT) Default: F ! LPRINT = T !  
(F = Do not print, T = Print)  
(NOTE: parameters below control which  
met. variables are printed)

Print interval  
(IPRINF) in hours Default: 1 ! IPRINF = 1 !  
(Meteorological fields are printed  
every 1 hours)

Specify which layers of U, V wind component  
to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered  
(0=Do not print, 1=Print)  
(used only if LPRINT=T) Defaults: NZ\*0  
! IUVOUT = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 !

---

Specify which levels of the W wind component to print  
(NOTE: W defined at TOP cell face -- 10 values)  
(IWOUT(NZ)) -- NOTE: NZ values must be entered  
(0=Do not print, 1=Print)  
(used only if LPRINT=T & LCALGRD=T)

---

Defaults: NZ\*0  
! IWOUT = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 !

Specify which levels of the 3-D temperature field to print

(ITOUT(NZ)) -- NOTE: NZ values must be entered  
(0=Do not print, 1=Print)  
(used only if LPRINT=T & LCALGRD=T)

-----  
                  Defaults: NZ\*0  
! ITOUT = 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 !

Specify which meteorological fields  
to print  
(used only if LPRINT=T)        Defaults: 0 (all variables)

-----  
Variable        Print ?

(0 = do not print,  
1 = print)

-----  
! STABILITY =    0        ! - PGT stability class  
! USTAR     =    0        ! - Friction velocity  
! MONIN    =    0        ! - Monin-Obukhov length  
! MIXHT    =    0        ! - Mixing height  
! WSTAR    =    0        ! - Convective velocity scale  
! PRECIP   =    0        ! - Precipitation rate  
! SENSHEAT =    0        ! - Sensible heat flux  
! CONVZI   =    0        ! - Convective mixing ht.

Testing and debug print options for micrometeorological module

Print input meteorological data and  
internal variables (LDB)       Default: F       ! LDB = F !  
(F = Do not print, T = print)  
(NOTE: this option produces large amounts of output)

First time step for which debug data  
are printed (NN1)       Default: 1       ! NN1 = 1 !

Last time step for which debug data  
are printed (NN2)       Default: 1       ! NN2 = 2 !

Testing and debug print options for wind field module  
(all of the following print options control output to  
wind field module's output files: TEST.PRT, TEST.OUT,  
TEST.KIN, TEST.FRД, and TEST.SLP)

Control variable for writing the test/debug  
wind fields to disk files (IOUTD)  
(0=Do not write, 1=write)       Default: 0       ! IOUTD = 0 !

Number of levels, starting at the surface,  
to print (NZPRN2)       Default: 1       ! NZPRN2 = 1 !

Print the INTERPOLATED wind components ?  
(IPR0) (0=no, 1=yes)       Default: 0       ! IPR0 = 0 !

Print the TERRAIN ADJUSTED surface wind  
components ?

(IPR1) (0=no, 1=yes) Default: 0 ! IPR1 = 0 !

Print the SMOOTHED wind components and  
the INITIAL DIVERGENCE fields ?

(IPR2) (0=no, 1=yes) Default: 0 ! IPR2 = 0 !

Print the FINAL wind speed and direction  
fields ?

(IPR3) (0=no, 1=yes) Default: 0 ! IPR3 = 0 !

Print the FINAL DIVERGENCE fields ?

(IPR4) (0=no, 1=yes) Default: 0 ! IPR4 = 0 !

Print the winds after KINEMATIC effects  
are added ?

(IPR5) (0=no, 1=yes) Default: 0 ! IPR5 = 0 !

Print the winds after the FROUDE NUMBER  
adjustment is made ?

(IPR6) (0=no, 1=yes) Default: 0 ! IPR6 = 0 !

Print the winds after SLOPE FLOWS  
are added ?

(IPR7) (0=no, 1=yes) Default: 0 ! IPR7 = 0 !

Print the FINAL wind field components ?

(IPR8) (0=no, 1=yes) Default: 0 ! IPR8 = 0 !

!END!

---

INPUT GROUP: 4 -- Meteorological data options

---

#### NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

Number of surface stations (NSSTA) No default ! NSSTA = 22 !

Number of precipitation stations

(NPSTA) No default ! NPSTA = 67 !

#### CLOUD DATA OPTIONS

Gridded cloud fields:

(ICLOUD) Default: 0 ! ICLOUD = 0 !

ICLOUD = 0 - Gridded clouds not used

ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT

ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT

#### FILE FORMATS

Surface meteorological data file format

(IFORMS) Default: 2 ! IFORMS = 2 !

(1 = unformatted (e.g., SMERGE output))

(2 = formatted (free-formatted user input))

Precipitation data file format

(IFORMP) Default: 2 ! IFORMP = 2 !

(1 = unformatted (e.g., PMERGE output))

(2 = formatted (free-formatted user input))

Cloud data file format

(IFORMC) Default: 2 ! IFORMC = 2 !

(1 = unformatted - CALMET unformatted output)

(2 = formatted - free-formatted CALMET output or user input)

!END!

-----  
INPUT GROUP: 5 -- Wind Field Options and Parameters  
-----

#### WIND FIELD MODEL OPTIONS

Model selection variable (IWFCOD) Default: 1 ! IWFCOD = 1 !

0 = Objective analysis only

1 = Diagnostic wind module

Compute Froude number adjustment

effects ? (IFRADJ) Default: 1 ! IFRADJ = 1 !

(0 = NO, 1 = YES)

Compute kinematic effects ? (IKINE) Default: 1 ! IKINE = 0 !

(0 = NO, 1 = YES)

Use O'Brien procedure for adjustment

of the vertical velocity ? (IOBR) Default: 0 ! IOBR = 0 !

(0 = NO, 1 = YES)

Compute slope flow effects ? (ISLOPE) Default: 1 ! ISLOPE = 1 !

(0 = NO, 1 = YES)

Extrapolate surface wind observations

to upper layers ? (IEXTRP) Default: -4 ! IEXTRP = -4 !

(1 = no extrapolation is done,

2 = power law extrapolation used,

3 = user input multiplicative factors

for layers 2 - NZ used (see FEXTRP array)

4 = similarity theory used

-1, -2, -3, -4 = same as above except layer 1 data

at upper air stations are ignored

Extrapolate surface winds even

if calm? (ICALM) Default: 0 ! ICALM = 0 !

(0 = NO, 1 = YES)

Layer-dependent biases modifying the weights of  
surface and upper air stations (BIAS(NZ))

-1<=BIAS<=1

Negative BIAS reduces the weight of upper air stations

(e.g. BIAS=-0.1 reduces the weight of upper air stations  
by 10%; BIAS= -1, reduces their weight by 100 %)

Positive BIAS reduces the weight of surface stations

(e.g. BIAS= 0.2 reduces the weight of surface stations

by 20%; BIAS=1 reduces their weight by 100%)  
Zero BIAS leaves weights unchanged ( $1/R^{**2}$  interpolation)  
Default: NZ\*0  
    ! BIAS = 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 !

Minimum distance from nearest upper air station  
to surface station for which extrapolation  
of surface winds at surface station will be allowed  
(RMIN2: Set to -1 for IEXTRP = 4 or other situations  
where all surface stations should be extrapolated)

Default: 4. ! RMIN2 = 10.0 !

Use gridded prognostic wind field model  
output fields as input to the diagnostic  
wind field model (IPROG)      Default: 0      ! IPROG = 4 !  
(0 = No, [IWFCOD = 0 or 1]  
1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]  
2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]  
3 = Yes, use MM4 prog. winds as Step 1 field [IWFCOD = 0]  
4 = Yes, use MM4 prog. winds as initial guess field [IWFCOD = 1]  
5 = Yes, use MM4 prog. winds as observations [IWFCOD = 1]

#### RADIUS OF INFLUENCE PARAMETERS

Use varying radius of influence      Default: F      ! LVARY = F!  
(if no stations are found within RMAX1,RMAX2,  
or RMAX3, then the closest station will be used)

Maximum radius of influence over land  
in the surface layer (RMAX1)      No default      ! RMAX1 = 100. !  
                                        Units: km

Maximum radius of influence over land  
aloft (RMAX2)      No default      ! RMAX2 = 100. !  
                                        Units: km

Maximum radius of influence over water  
(RMAX3)      No default      ! RMAX3 = 100. !  
                                        Units: km

#### OTHER WIND FIELD INPUT PARAMETERS

Minimum radius of influence used in  
the wind field interpolation (RMIN)      Default: 0.1      ! RMIN = 0.1 !  
    Units: km

Radius of influence of terrain  
features (TERRAD)      No default      ! TERRAD = 30. !  
    Units: km

Relative weighting of the first  
guess field and observations in the  
SURFACE layer (R1)      No default      ! R1 = 15. !  
(R1 is the distance from an      Units: km  
observational station at which the  
observation and first guess field are  
equally weighted)

Relative weighting of the first  
guess field and observations in the

layers ALOFT (R2) No default ! R2 = 15. !  
(R2 is applied in the upper layers Units: km  
in the same manner as R1 is used in  
the surface layer).

Relative weighting parameter of the  
prognostic wind field data (RPROG) No default ! RPROG = 0. !  
(Used only if IPROG = 1) Units: km

-----  
Maximum acceptable divergence in the  
divergence minimization procedure  
(DIVLIM) Default: 5.E-6 ! DIVLIM= 5.0E-06 !

Maximum number of iterations in the  
divergence min. procedure (NITER) Default: 50 ! NITER = 50 !

Number of passes in the smoothing  
procedure (NSMTH(NZ))  
NOTE: NZ values must be entered  
Default: 2,(mxnz-1)\*4 ! NSMTH =  
2, 4, 4, 4, 4, 4, 4, 4, 4 !

Maximum number of stations used in  
each layer for the interpolation of  
data to a grid point (NINTR2(NZ))  
NOTE: NZ values must be entered Default: 99. ! NINTR2 =  
99, 99, 99, 99, 99, 99, 99, 99, 99 !

Critical Froude number (CRITFN) Default: 1.0 ! CRITFN = 1. !

Empirical factor controlling the  
influence of kinematic effects  
(ALPHA) Default: 0.1 ! ALPHA = 0.1 !

Multiplicative scaling factor for  
extrapolation of surface observations  
to upper layers (FEXTR2(NZ)) Default: NZ\*0.0  
! FEXTR2 = 0., 0., 0., 0., 0., 0., 0., 0., 0. !  
(Used only if IEXTNP = 3 or -3)

## BARRIER INFORMATION

Number of barriers to interpolation  
of the wind fields (NBAR) Default: 0 ! NBAR = 0 !

THE FOLLOWING 4 VARIABLES ARE INCLUDED  
ONLY IF NBAR > 0  
NOTE: NBAR values must be entered No defaults  
for each variable Units: km

X coordinate of BEGINNING  
of each barrier (XBBAR(NBAR)) ! XBBAR = 0. !  
Y coordinate of BEGINNING  
of each barrier (YBBAR(NBAR)) ! YBBAR = 0. !

X coordinate of ENDING

of each barrier (XEBAR(NBAR)) ! XEBAR = 0. !  
Y coordinate of ENDING  
of each barrier (YEBAR(NBAR)) ! YEBAR = 0. !

#### DIAGNOSTIC MODULE DATA INPUT OPTIONS

Surface temperature (IDIOPT1) Default: 0 ! IDIOPT1 = 0 !  
0 = Compute internally from  
hourly surface observations  
1 = Read preprocessed values from  
a data file (DIAG.DAT)

Surface met. station to use for  
the surface temperature (ISURFT) No default ! ISURFT = 4 !  
(Must be a value from 1 to NSSTA)  
(Used only if IDIOPT1 = 0)

-----

Domain-averaged temperature lapse  
rate (IDIOPT2) Default: 0 ! IDIOPT2 = 0 !  
0 = Compute internally from  
twice-daily upper air observations  
1 = Read hourly preprocessed values  
from a data file (DIAG.DAT)

Upper air station to use for  
the domain-scale lapse rate (IUPT) No default ! IUPT = 3 !  
(Must be a value from 1 to NUSTA)  
(Used only if IDIOPT2 = 0)

-----

Depth through which the domain-scale  
lapse rate is computed (ZUPT) Default: 200. ! ZUPT = 200. !  
(Used only if IDIOPT2 = 0) Units: meters

-----

Domain-averaged wind components  
(IDIOPT3) Default: 0 ! IDIOPT3 = 0 !  
0 = Compute internally from  
twice-daily upper air observations  
1 = Read hourly preprocessed values  
from a data file (DIAG.DAT)

Upper air station to use for  
the domain-scale winds (IUPWND) Default: -1 ! IUPWND = -1 !  
(Must be a value from -1 to NUSTA)  
(Used only if IDIOPT3 = 0)

-----

Bottom and top of layer through  
which the domain-scale winds  
are computed  
(ZUPWND(1), ZUPWND(2)) Defaults: 1., 1000. ! ZUPWND= 1., 1000. !  
(Used only if IDIOPT3 = 0) Units: meters

-----

Observed surface wind components

for wind field module (IDIOPT4) Default: 0 ! IDIOPT4 = 0 !  
0 = Read WS, WD from a surface  
data file (SURF.DAT)  
1 = Read hourly preprocessed U, V from  
a data file (DIAG.DAT)

Observed upper air wind components  
for wind field module (IDIOPT5) Default: 0 ! IDIOPT5 = 0 !  
0 = Read WS, WD from an upper  
air data file (UP1.DAT, UP2.DAT, etc.)  
1 = Read hourly preprocessed U, V from  
a data file (DIAG.DAT)

#### LAKE BREEZE INFORMATION

Use Lake Breeze Module (LLBREEZE)  
Default: F ! LLBREEZE = F !

Number of lake breeze regions (NBOX) ! NBOX = 0 !

X Grid line 1 defining the region of interest  
! XG1 = 0. !  
X Grid line 2 defining the region of interest  
! XG2 = 0. !  
Y Grid line 1 defining the region of interest  
! YG1 = 0. !  
Y Grid line 2 defining the region of interest  
! YG2 = 0. !

X Point defining the coastline (Straight line)  
(XBCST) (KM) Default: none ! XBCST = 0. !

Y Point defining the coastline (Straight line)  
(YBCST) (KM) Default: none ! YBCST = 0. !

X Point defining the coastline (Straight line)  
(XECST) (KM) Default: none ! XECST = 0. !

Y Point defining the coastline (Straight line)  
(YECST) (KM) Default: none ! YECST = 0. !

Number of stations in the region Default: none ! NLB = 0 !  
(Surface stations + upper air stations)

Station ID's in the region (METBXID(NLB))  
(Surface stations first, then upper air stations)  
! METBXID = 0 !

!END!

---

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters

---

#### EMPIRICAL MIXING HEIGHT CONSTANTS

Neutral, mechanical equation  
 (CONSTB) Default: 1.41 ! CONSTB = 1.41 !  
 Convective mixing ht. equation  
 (CONSTE) Default: 0.15 ! CONSTE = 0.15 !  
 Stable mixing ht. equation  
 (CONSTN) Default: 2400. ! CONSTN = 2400.!  
 Overwater mixing ht. equation  
 (CONSTW) Default: 0.16 ! CONSTW = 0.16 !  
 Absolute value of Coriolis  
 parameter (FCORIOL) Default: 1.E-4 ! FCORIOL = 1.0E-04!  
 Units: (1/s)

#### Spatial Averaging of Mixing Heights

Conduct spatial averaging  
 (IAVEZI) (0=no, 1=yes) Default: 1 ! IAVEZI = 1 !  
 Max. search radius in averaging  
 process (MNMDAV) Default: 1 ! MNMDAV = 4 !  
 Units: Grid  
 cells  
 Half-angle of upwind looking cone  
 for averaging (HAFANG) Default: 30. ! HAFANG = 30. !  
 Units: deg.  
 Layer of winds used in upwind  
 averaging (ILEVZI) Default: 1 ! ILEVZI = 1 !  
 (must be between 1 and NZ)

#### Other Mixing Height Variables

Minimum potential temperature lapse  
 rate in the stable layer above the  
 current convective mixing ht. Default: 0.001 ! DPTMIN = 0.001 !  
 (DPTMIN) Units: deg. K/m  
 Depth of layer above current conv.  
 mixing height through which lapse Default: 200. ! DZZI = 200. !  
 rate is computed (DZZI) Units: meters  
 Minimum overland mixing height Default: 50. ! ZIMIN = 50. !  
 (ZIMIN) Units: meters  
 Maximum overland mixing height Default: 3000. ! ZIMAX = 3000. !  
 (ZIMAX) Units: meters  
 Minimum overwater mixing height Default: 50. ! ZIMINW = 50. !  
 (ZIMINW) -- (Not used if observed Units: meters  
 overwater mixing hts. are used)  
 Maximum overwater mixing height Default: 3000. ! ZIMAXW = 3000. !  
 (ZIMAXW) -- (Not used if observed Units: meters  
 overwater mixing hts. are used)

#### Temperature Parameters

Interpolation type  
 (1 = 1/R ; 2 = 1/R\*\*2) Default:1 ! IRAD = 1 !  
 Radius of influence for temperature  
 interpolation (TRADKM) Default: 500. ! TRADKM = 500. !  
 Units: km

Maximum Number of stations to include  
in temperature interpolation (NUMTS) Default: 5 ! NUMTS = 5 !

Conduct spatial averaging of temperatures (IAVET) (0=no, 1=yes) Default: 1 ! IAVET = 1 !  
(will use mixing ht MNMDAV,HAFANG  
so make sure they are correct)

Default temperature gradient Default: -.0098 ! TGDEFB = -0.0098 !  
below the mixing height over water (K/m) (TGDEFB)

Default temperature gradient Default: -.0045 ! TGDEFA = -0.0045 !  
above the mixing height over water (K/m) (TGDEFA)

Beginning (JWAT1) and ending (JWAT2)  
land use categories for temperature ! JWAT1 = 999 !  
interpolation over water -- Make ! JWAT2 = 999 !  
bigger than largest land use to disable

#### PRECIP INTERPOLATION PARAMETERS

Method of interpolation (NFLAGP) Default = 2 ! NFLAGP = 2 !  
(1=1/R,2=1/R\*\*2,3=EXP/R\*\*2)  
Radius of Influence (km) (SIGMAP) Default = 100.0 ! SIGMAP = 50. !  
(0.0 => use half dist. btwn  
nearest stns w & w/out  
precip when NFLAGP = 3)  
Minimum Precip. Rate Cutoff (mm/hr) Default = 0.01 ! CUTP = 0.01 !  
(values < CUTP = 0.0 mm/hr)  
!END!

---

#### INPUT GROUP: 7 -- Surface meteorological station parameters

---

##### SURFACE STATION VARIABLES (One record per station -- 22 records in all)

1	2	Name	ID	X coord. (km)	Y coord. (km)	Time zone	Anem. Ht.(m)
-----	-----	! SS1	='BAGZ'	1	74.800	-166.400	7 10 !
!	SS2	='CRME'	2	78.700	-225.600	7 6.1 !	
!	SS3	='TGSO'	3	-107.700	-91.600	7 10 !	
!	SS4	='OCT'	4	-89.900	-87.500	7 10 !	
!	SS5	='NAUT'	5	-163.800	-83.200	7 10 !	
!	SS6	='GCHM'	6	-97.400	-102.500	7 10 !	
!	SS7	='AMCO'	7	-188.000	-117.800	7 10 !	
!	SS8	='EXON'	8	-128.500	-75.000	7 10 !	
!	SS9	='PINE'	9	-97.600	41.600	7 10 !	
!	SS10	='CENT'	10	194.100	-130.500	7 10 !	
!	SS11	='YELL'	11	-141.500	218.300	7 10 !	

```
! SS12 ='CRMO' 12 -391.200 111.100 7 10 !
! SS13 ='DENV' 3017 321.444 -281.130 7 10 !
! SS14 ='GRJT' 23066 1.400 -369.900 7 6.7 !
! SS15 ='CHEY' 24018 302.966 -142.920 7 10 !
! SS16 ='LAND' 24021 -14.429 28.720 7 10 !
! SS17 ='ROCK' 24027 -41.600 -102.100 7 10 !
! SS18 ='CASP' 24089 163.900 41.600 7 6.1 !
! SS19 ='SLCY' 24127 -277.300 -184.300 7 6.1 !
! SS20 ='POCT' 24156 -318.700 47.500 7 6.1 !
! SS21 ='RAWL' 72574 108.300 -79.800 7 10 !
! SS22 ='RIVR' 72576 7.900 53.800 7 10 !
-----
```

1

Four character string for station name  
(MUST START IN COLUMN 9)

2

Five digit integer for station ID

!END!

```
-----
```

INPUT GROUP: 8 -- Upper air meteorological station parameters

```
-----
```

#### UPPER AIR STATION VARIABLES

(One record per station -- 4 records in all)

1 2

Name	ID	X coord.	Y coord.	Time zone
		(km)	(km)	

```
-----
```

```
! US1 ='DENV' 23062 305.400 -292.700 7 !
! US2 ='GRJT' 23066 1.400 -369.900 7 !
! US3 ='LAND' 24021 -14.429 28.720 7 !
! US4 ='SLCY' 24127 -277.300 -184.300 7 !
-----
```

1

Four character string for station name  
(MUST START IN COLUMN 9)

2

Five digit integer for station ID

!END!

```
-----
```

INPUT GROUP: 9 -- Precipitation station parameters

```
-----
```

#### PRECIPITATION STATION VARIABLES

(One record per station -- 67 records in all)  
(NOT INCLUDED IF NPSTA = 0)

1	2	
Name	Station X coord.	Y coord.
Code	(km)	(km)
! PS1	='ALLN'	050183 248.3711 -246.4950 !
! PS2	='BOUL'	050843 271.0708 -265.4616 !
! PS3	='DINO'	052286 -34.3280 -249.3598 !
! PS4	='DRKE'	052354 263.8916 -222.5848 !
! PS5	='FCLL'	053005 283.6870 -205.5760 !
! PS6	='FCL9'	053007 272.3520 -196.9968 !
! PS7	='GRL6'	053500 221.0088 -251.1382 !
! PS8	='LON6'	055121 279.7318 -241.6763 !
! PS9	='MEEK'	055484 49.5676 -272.5594 !
! PS10	='NGTE'	055982 180.3954 -171.5098 !
! PS11	='RUST'	057296 231.3231 -193.1856 !
! PS12	='SLKE'	057648 244.9917 -266.4799 !
! PS13	='WFRK'	059096 192.6576 -268.2126 !
! PS14	='GRCE'	103732 -251.9060 8.5559 !
! PS15	='HNRY'	104230 -233.5570 41.9532 !
! PS16	='IDFL'	104456 -252.5330 91.0828 !
! PS17	='TETO'	109065 -210.4223 143.2691 !
! PS18	='ARGT'	420342 -254.8533 -201.3690 !
! PS19	='BVAL'	420820 -271.5315 -177.2966 !
! PS20	='COAL'	421590 -211.5493 -170.5724 !
! PS21	='CTTN'	421759 -264.4021 -202.7156 !
! PS22	='ECHO'	422385 -234.4341 -166.1238 !
! PS23	='FGRG'	422864 -70.5543 -173.6253 !
! PS24	='HANA'	423624 -181.9849 -228.9243 !
! PS25	='KAY1'	424538 -274.8422 -159.1525 !
! PS26	='LSTU'	425186 -260.8413 -80.7534 !
! PS27	='L5SW'	425194 -269.2361 -89.3470 !
! PS28	='MOON'	425815 -159.6343 -211.4989 !
! PS29	='MDAM'	425892 -258.4411 -188.6110 !
! PS30	='NEOL'	426127 -124.2616 -215.9303 !
! PS31	='OAK3'	426374 -219.0219 -191.8844 !
! PS32	='OGDP'	426404 -275.1573 -134.0249 !
! PS33	='OLMS'	426455 -254.7827 -235.4594 !
! PS34	='PBYU'	427064 -255.0623 -242.6781 !
! PS35	='ROOS'	427395 -116.5483 -243.0268 !
! PS36	='SLCY'	427598 -277.2924 -184.2788 !
! PS37	='SLKB'	427846 -248.1234 -205.1868 !
! PS38	='SHWY'	428371 -213.9985 -245.9745 !
! PS39	='UPAM'	428939 -261.1037 -222.6963 !
! PS40	='BIGP'	480697 -124.1436 -0.6128 !
! PS41	='BOYS'	481000 28.6418 93.2487 !
! PS42	='CASP'	481570 163.9418 41.5852 !
! PS43	='DGLS'	482693 249.9306 26.4448 !
! PS44	='DG17'	482696 266.0591 48.6209 !
! PS45	='DUBO'	482715 -84.3489 106.2164 !
! PS46	='ECMP'	483050 143.1114 -141.8417 !
! PS47	='EVAN'	483100 -194.5482 -146.6432 !
! PS48	='JACK'	484910 -172.8014 102.6668 !
! PS49	='JELM'	484930 205.5891 -154.5989 !
! PS50	='LAND'	485390 -14.4290 28.7201 !
! PS51	='LARM'	485420 235.8918 -130.1871 !
! PS52	='MBOW'	486120 188.1599 -67.1468 !
! PS53	='MORS'	486440 -157.4622 141.6978 !

```
! PS54 ='MTVW' 486555 -144.2864 -136.4311 !
! PS55 ='MSPG' 486597 -29.6763 -132.5858 !
! PS56 ='ORTR' 486875 29.0689 0.0666 !
! PS57 ='PATH' 487105 134.8304 -7.4929 !
! PS58 ='POWD' 487375 123.0924 53.1244 !
! PS59 ='RAWL' 487533 108.2839 -79.7551 !
! PS60 ='RIVR' 487760 13.1191 51.9336 !
! PS61 ='ROCK' 487845 -41.6090 -102.0561 !
! PS62 ='SARA' 487995 142.4391 -111.3819 !
! PS63 ='SDAM' 488070 130.2123 -41.6868 !
! PS64 ='SHIR' 488192 194.6274 -16.6994 !
! PS65 ='TENS' 488858 91.6866 136.8316 !
! PS66 ='THRM' 488875 27.2058 118.2748 !
! PS67 ='TH25' 488888 -11.6455 125.4230 !
```

---

1

Four character string for station name  
(MUST START IN COLUMN 9)

2

Six digit station code composed of state  
code (first 2 digits) and station ID (last  
4 digits)

!END!

## **3.0 EMISSION INVENTORY DEVELOPMENT**

This section summarizes the emission inventory used in the Desolation Flats Project ambient air quality impact analysis. More details on the emission inventory are provided in the "Emissions Inventory for the Desolation Flats Natural Gas Exploration and Development Project" (Buys and Associates, 2001). As discussed in the Emission Inventory Report, since the model was run for Calendar year 1995, emissions occurring prior to July 1, 1995 were considered part of the baseline, and emissions occurring after July 1, 1995 were explicitly modeled.

The emissions modeled for this study can be categorized as follows (the sub-sections of this report that discusses each emission category is noted):

- Background emissions occurring prior to July 1, 1995. (Subsection 3.1)
- Emissions associated with the Desolation Flats Project well field construction and development. (Subsection 3.2)
- Emissions associated with the Desolation Flats Project well field production and compressor engines. (Subsection 3.2)
- Emission increases from permitted point and fugitive sources (excluding individual wells) since July 1, 1995 through December 31, 2000 that are not related to the Desolation Flats Project. (Subsection 3.3)
- Emission reductions from known decreases at point and fugitive sources since 1995. (Subsection 3.4)
- Emission decreases associated with the NOx reduction project at the Naughton Power Plant. (Subsection 3.5)
- Emission increases and decreases since 1995 from individual wells in fields not related to Desolation Flats. (Subsection 3.6)
- Emission increases associated with Reasonably Foreseeable Development (RFD) (other than Desolation Flats) in Wyoming. The RFD sources are those sources that have been approved by the BLM, but are not yet permitted nor constructed. (Subsection 3.7)

Emissions inventories were developed for each of these activities for NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, VOCs, and HAPs. However, for the CALPUFF near- and far-field modeling, only NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> were modeled. There are emissions of CO also associated with some of these activities, but the impacts of CO would be much less than ambient air quality standards and CO is not associated with any AQARVs or PSD Class I or II increments.

### **3.1 Background Emissions From Sources in Operation Prior to July 1, 1995**

In order to account for emissions from point, fugitive, and well fields prior to 1995, a monitored ambient air quality background concentration will be added to CALPUFF model run results. The background concentrations used in the analysis were discussed in the Draft Protocol for the analysis and are summarized in Table 5-1.

### **3.2 Desolation Flats Project Sources**

There were three sets of Desolation Flats Project source emissions:

- Four compressor stations with 5,000 horsepower of compression at each site
- Two central gathering stations (gas plants) with 6,000 horsepower at each site
- Three area sources representing emissions from individual well sites, including construction, flares, heaters, drill rig engines, and wind erosion from disturbed surfaces.

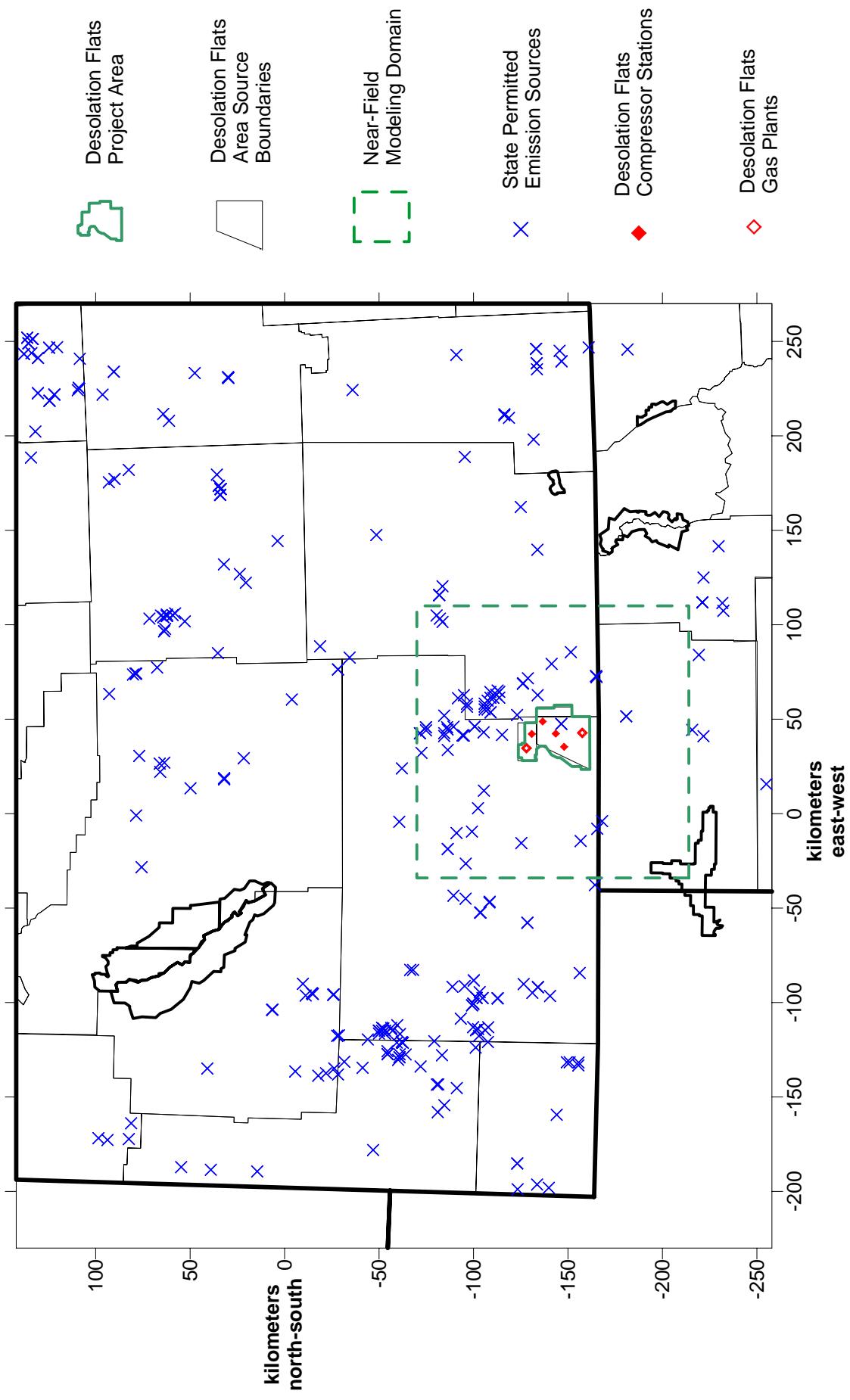
In the model, compressor and gathering station emissions were assumed to occur 24 hours per day, 365 days per year; while the heater emissions were assumed to occur mostly in winter (72% greater than average in winter, and 72% less than average in the summer). Emissions associated with construction were assumed to occur 8 hours per day (0800 through 1200 and 1300 through 1700). Typical locations for the gathering and compressor stations were selected throughout the Desolation Flats Project Area. The area sources were spread over three polygonal areas that approximately cover the entire Desolation Flats Project Area.

### **3.3 Permitted Point and Fugitive Emission Increases since July 1, 1995**

Permitted point source emissions since July 1, 1995 through December 31, 2000 were developed from previous EIS studies plus Colorado and Wyoming agency permit files as described in the Emissions Inventory Report. The CD/WII/SB and Pinedale Anticline air quality studies had extensive permitted source inventories that served as starting points for the inventory developed for this analysis. There were 267 point sources and 64 fugitive sources included in the permitted emission inventory that began operation or experienced emission increases since 1995. For these sources, the same seasonal (more heater emissions in the winter) and daily (for daytime operations) emission variations used by CD/WII/SB were included. Figure 3-1 presents the location of the permitted point and area sources. Figure 3-1 also shows the compressor station and gas plant locations for the project in addition to the area source boundaries utilized for the individual well field emissions located within the Desolation Flats Project Area.

As noted previously, there were two sets of CALPUFF model runs, one for far-field receptors (50 to over 350 km from Desolation Flats) and one for near-field receptors (4 to 50 km receptors from Desolation Flats). For the near-field model, run, only those sources within the near-field region, a square 140 km by 140 km (i.e., 50 km each direction beyond the Desolation Flats Project boundary) were modeled. The near-field region is also shown on Figure 3-1. There were 100 point and 8 fugitive sources located within the near-field region (out of 267 total point and 64 total fugitive sources).

**Figure 3-1**  
**State Permitted and Project Related Source Locations**



### **3.4 Permitted Point and Fugitive Emission Decreases since July 1, 1995**

Eighteen point and 7 fugitive sources in the model domain had known permitted emission decreases since 1995. The location of these sources are shown in Figure 3-2. Of these sources, 4 point and no fugitive sources were included in the near-field region.

### **3.5 Naughton Power Plant NOx Reduction Project**

In 1999 the Naughton Power Plant installed low emission burners on boiler #3 in order to reduce emissions of NOx from the power plant by 1,000 tons per year (as documented in the permit modification and emission inventories submitted to the State of Wyoming). The Naughton Power Plant is located at Lambert Conformal Projection (LCP) coordinates X = -164.33 km, Y = -83.15 km; approximately 180 km west-northwest of the Desolation Flats Project Area and 130 km south-southwest of the Bridger Wilderness Area. This emission reduction was included in the model run for the far-field (but not the near-field since the Plant is outside the near-field region. The Naughton Power Plant location is noted on Figure 3-2.

### **3.6 Emission Changes from Point, Fugitive and Well Field Sources Since 1995**

Well field emission decreases and increases from natural gas development in areas other than Desolation Flats were represented as area sources within each county. Both emission increases and emission decreases associated with well field production were modeled. Figure 3-3 presents the area within each county that contained the modeled emission increases or decreases. The counties with net emission decreases were:

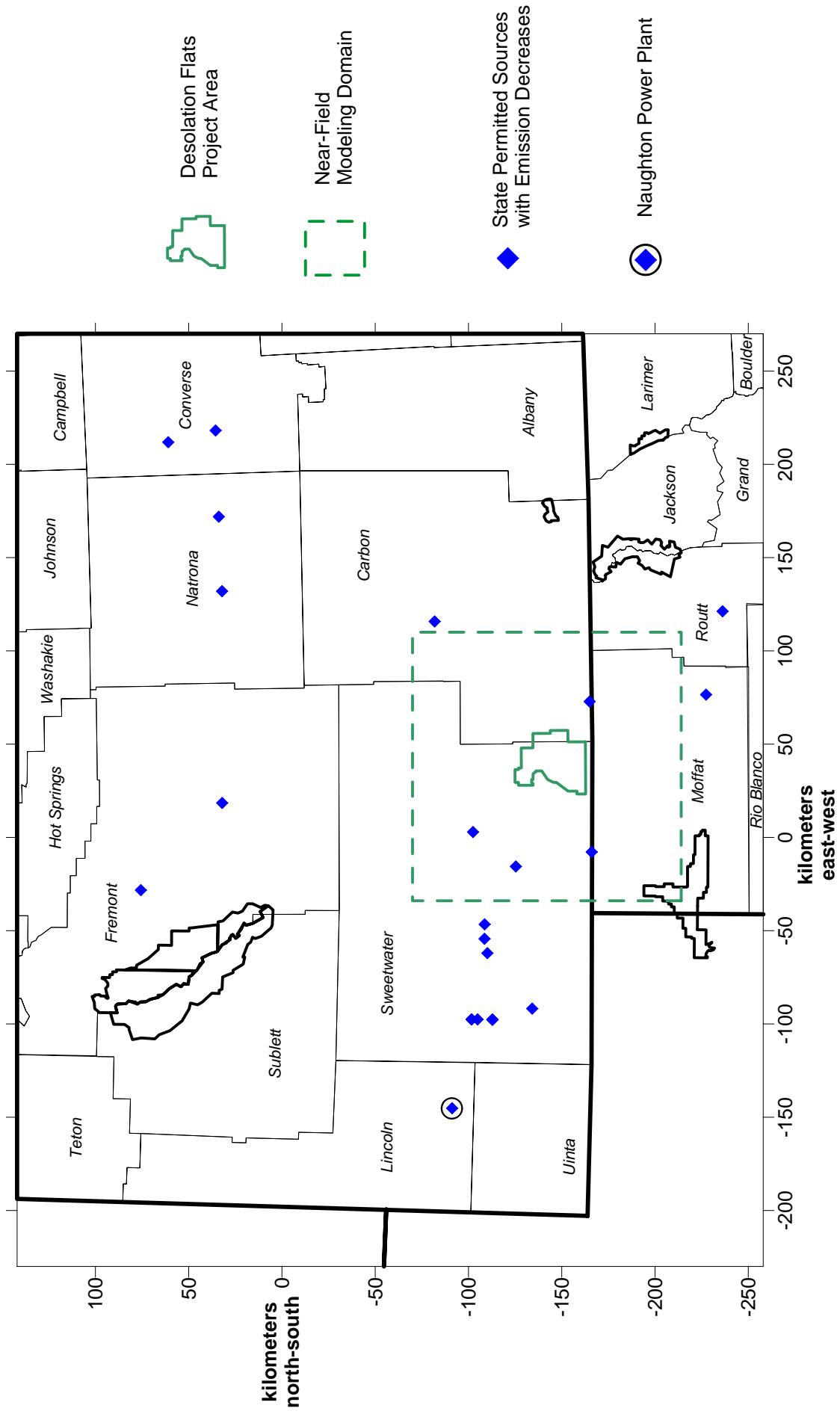
- Albany
- Converse
- Lincoln
- Moffat
- Routt
- Sweetwater (not including Desolation Flats Project)
- Uintah

The counties with net emission increases were:

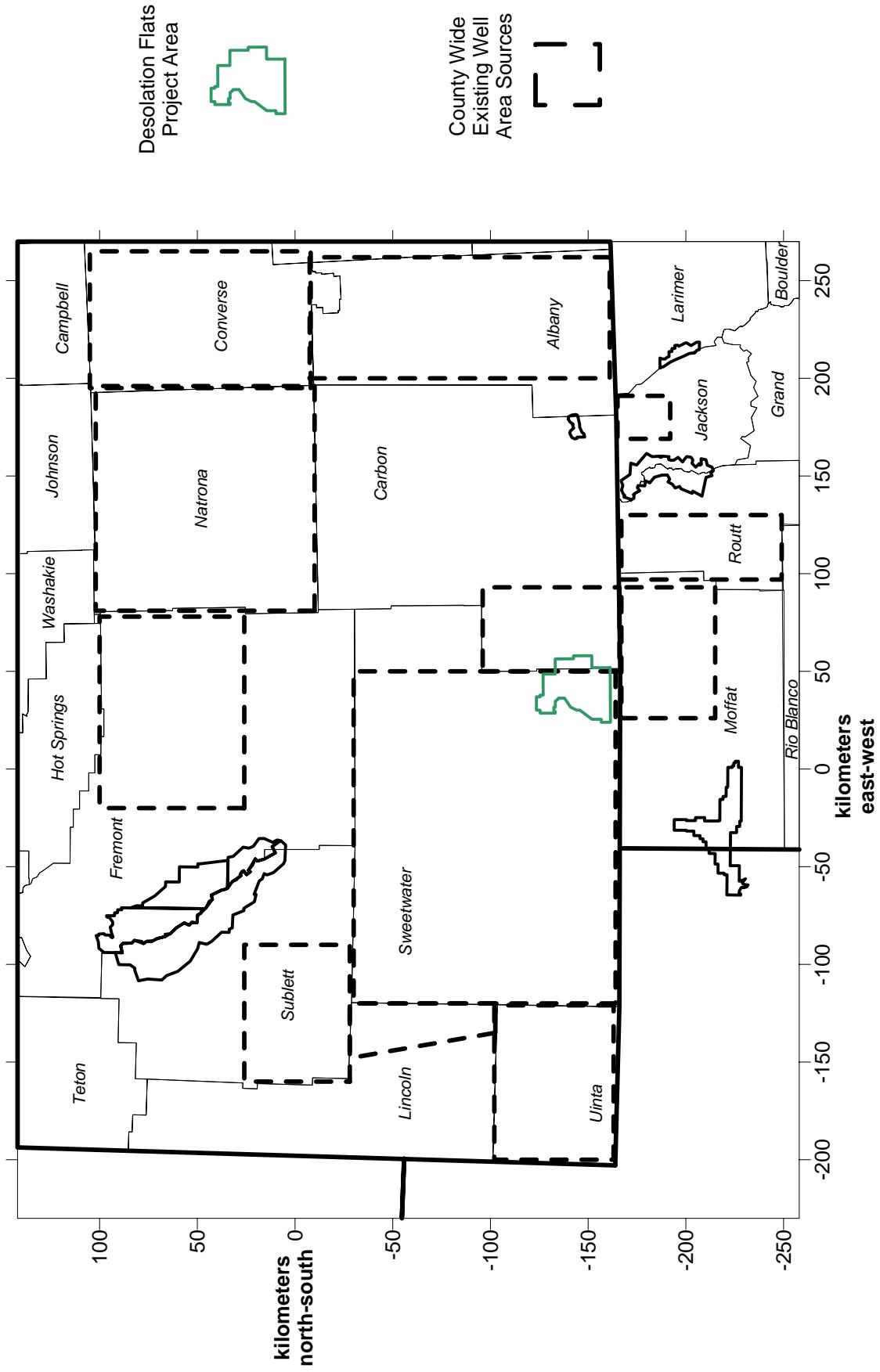
- Carbon
- Fremont
- Jackson
- Natrona
- Sublette

Only emission decreases in Sweetwater and Moffat counties and emission increases in Carbon county are within the near-field modeling region.

**Figure 3-2**  
**Permitted Source Emission Decreases**



**Figure 3-3**  
**County Wide Existing Well Emissin Increases and Decreases**



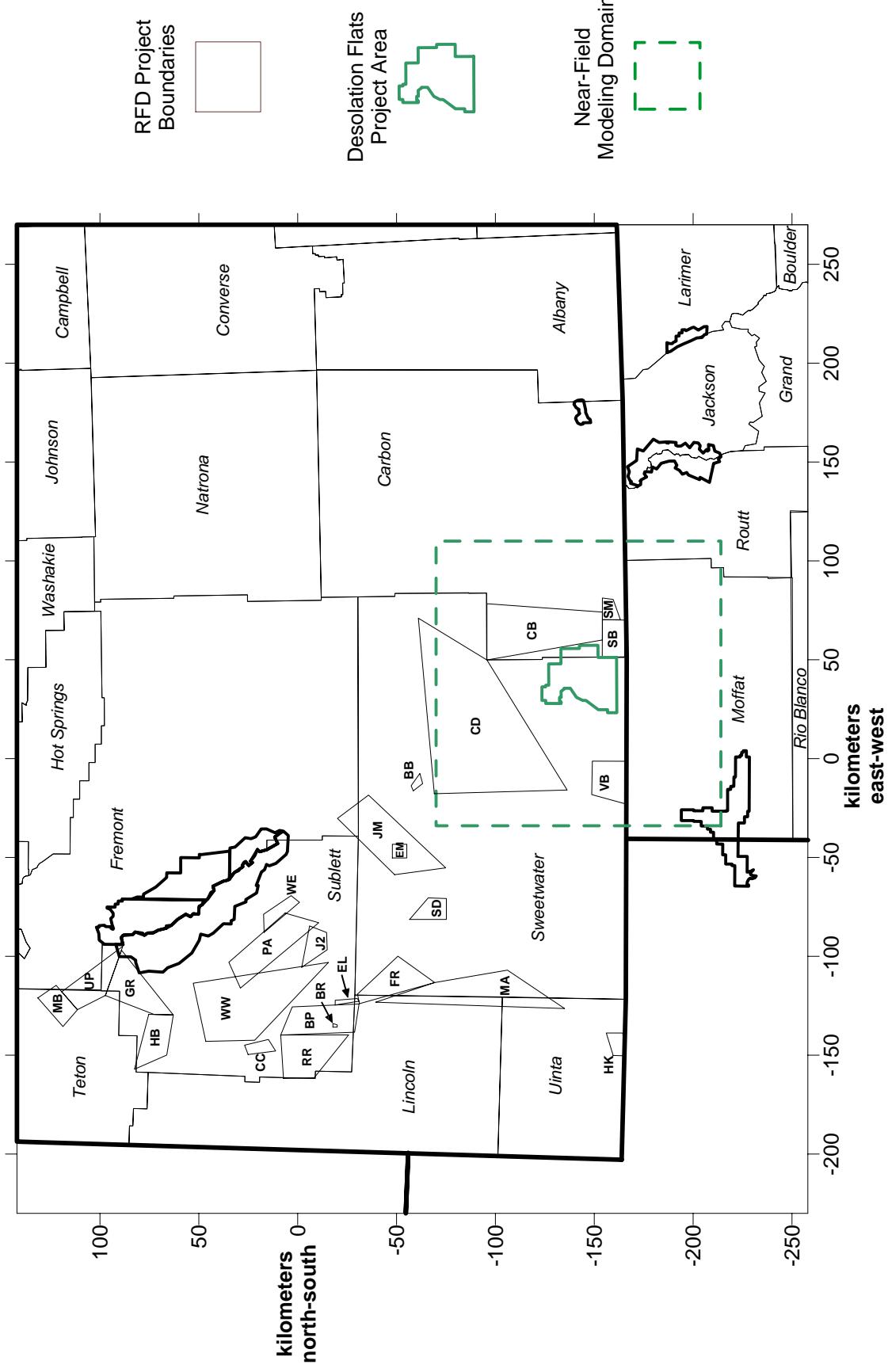
### 3.7 Emission Increases Associated with Reasonably Foreseeable Development

Emission increases associated with Reasonably Foreseeable Development (RFD) were developed as discussed in the Emission Inventory Report and include approved NEPA actions that are only partially developed or have yet to begin development. Only NOx emissions were estimated for RFD sources since emissions of other pollutants are insignificant. Projects included in the RFD inventory are shown on Figure 3-4 and include the following 29 areas, with 5 of those areas within the near-field region. The approved projects are summarized in Table 3-1.

Table 3-1 Approved RFD Projects

Approved NEPA Action	Map Symbol	Approved NEPA Action	Map Symbol
Bird Canyon	BC	Moxa Arch	MA
BTA Bravo	BB	Pinedale Anticline EIS	PA
Burley	BR	Riley Ridge	RR
CAP Big Piney - Labarge	BP	Road Hollow Gas Plant EA	RH
Castle Creek Unit	CC	Sierra Madre	SM
Continental Divide/Wamsutter II	CD	Soda Unit EA	SU
Creston/Blue Gap	CB	South Baggs	SB
East LaBarge	EL	Stagecoach Draw	SD
Essex Mountain	EM	Vermillion Basin	VB
Fontenelle Reservoir	FR	Bridger-Teton DEIS including Mngt. Areas:	
Hay Reservoir	HR		
Hickey-Table Mountain EA	HK	21 - Hoback Basin	HB
Jack Morrow Hills CAP EIS	JM	45 - Moccasin Basin	MB
Jonah II EIS	J2	71 - Union Pass	UP
Miscellaneous Wells - East	WE	72 - Upper Green River	GR
Miscellaneous Wells - West	WW		

**Figure 3-4**  
**Reasonably Foreseeable Development Projects**



## **4.0 CALPUFF DISPERSION MODELING**

The CALPUFF model uses the CALMET meteorological output and the emission inventory, along with another extensive set of input parameters to calculate ambient concentrations of pollutants at each model receptor. An example input file (for Desolation Flats Project Sources, Far-Field Receptors, January 1995) is presented in Exhibit 4-1 located at the end of this section. The input parameters utilized for the analysis are the default values except when project specific modeling requirements (i.e., receptor locations) differ.

### **4.1 Model Receptors**

Other than the source emission rates, one of the major inputs to the CALPUFF model is the receptor locations. There were two sets of receptor grids used in the CALPUFF modeling, near-field and far-field. The near-field receptor grid included the region within 50 km of the boundary for the Desolation Flats Project Area, while the far-field receptor grids included the identified sensitive areas.

The near-field receptor grid was a rectilinear grid of 4 km spacing within the 140 km by 140 km near-field region, which resulted in a 35 by 35 grid for a total of 1,225 receptors. The far-field receptor grid included 413 receptors (shown on Figure 4-1) consisting of the following:

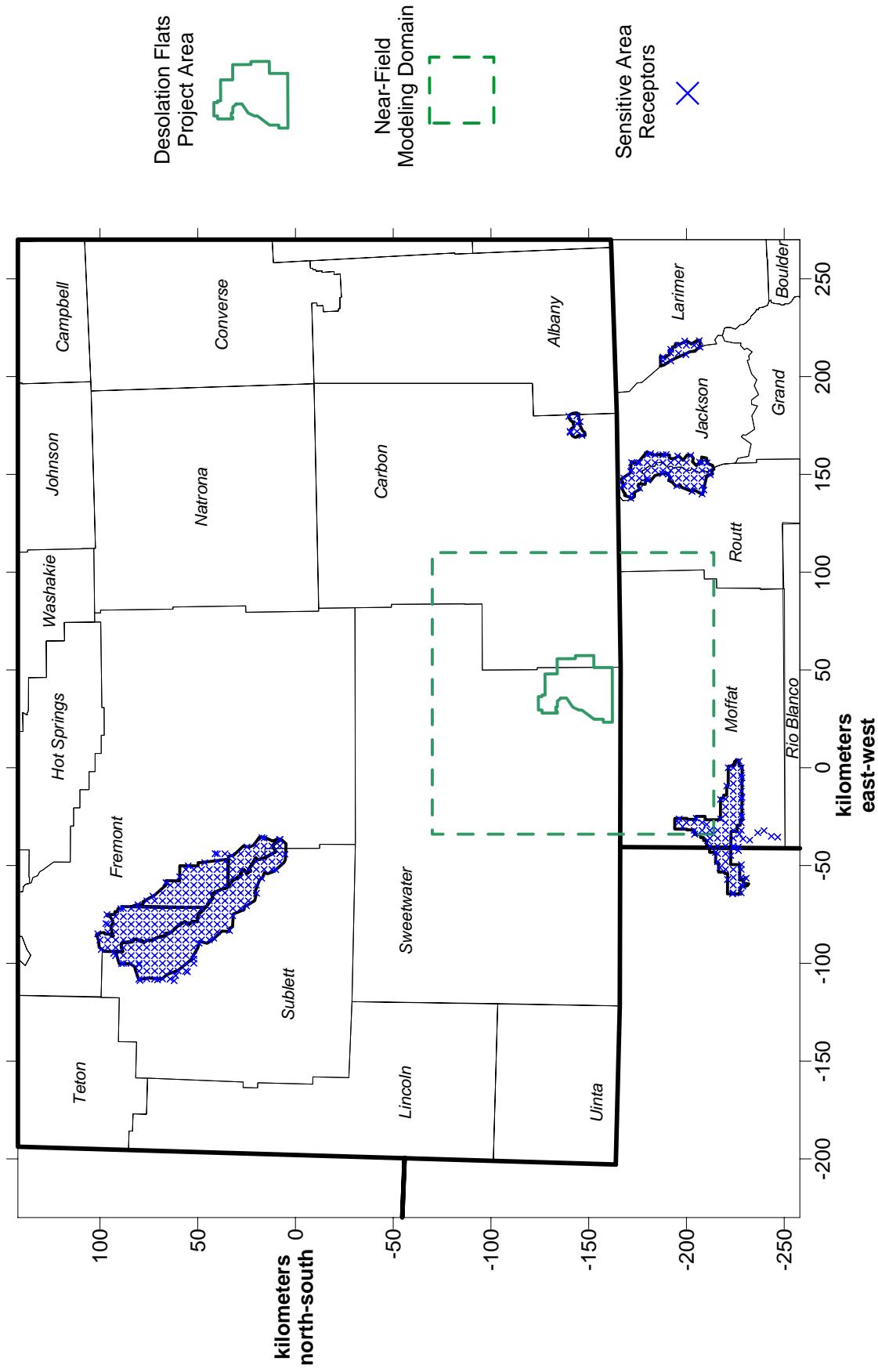
- 4 km rectilinear grid within each of the eight sensitive areas
- Receptors placed at least every 10 km along the boundary of each sensitive area
- Twelve sensitive lakes that were evaluated for acid deposition

The sensitive areas evaluated were the following:

- Bridger Wilderness Area (Class I)
- Fitzpatrick Wilderness Area (Class I)
- Wind River Roadless Area (Class II)
- Popo Agie Wilderness Area (Class II)
- Dinosaur National Monument (Class II)
- Savage Run Wilderness Area (Class I)
- Mount Zirkel Wilderness Area (Class I)
- Rawah Wilderness Area (Class I)

The twelve sensitive lakes evaluated are listed in Table 4-1 along with the representative background acid neutralizing capacity (ANC) levels. The background ANC data were obtained from USFS and USGS sources and represent measurements collected through the year 2000. The basis for the background ANC data is the 10<sup>th</sup> percentile of measurements observed at the lake outlet when greater than five years of data exist. When five or less years of data were available, average values were utilized. The location of the sensitive lakes are presented in Figure 4-2.

**Figure 4-1**  
**Sensitive Area Receptors**



## Figure 4-2 Sensitive Lake Receptors

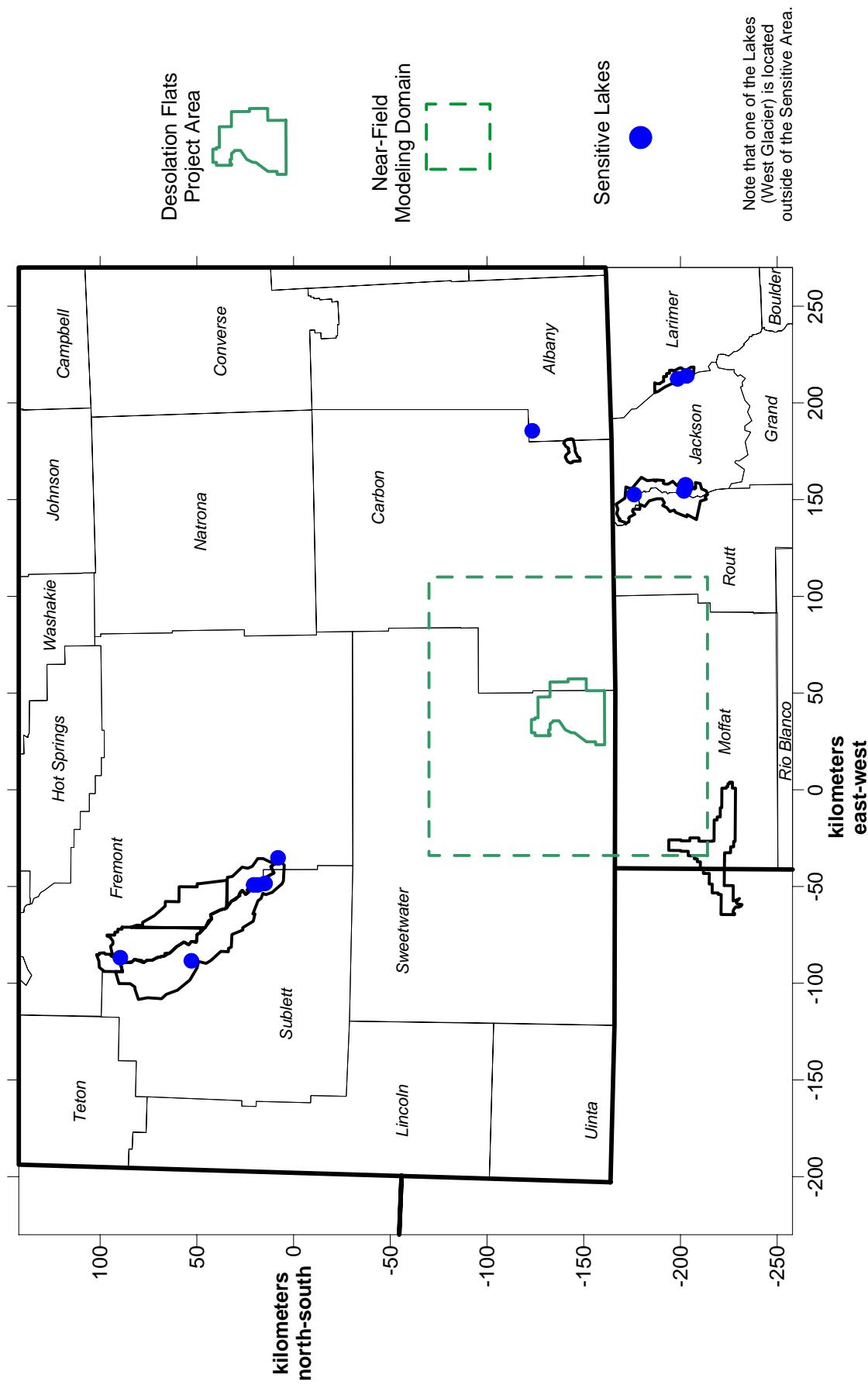


Table 4-1 Sensitive Lakes Evaluated for Excess Acid Deposition

Wilderness Area	Sensitive Lake	Background ANC ( $\mu\text{eq/l}$ )
Bridger	Black Joe Lake	69.0
	Deep Lake	61.0
	Hobbs Lake	68.0
	Upper Frozen Lake	5.7
Fitzpatrick	Ross Lake	61.4
Popo Agie	Lower Saddlebag	55.5
Mt. Zirkel	Pothole A-8	16.0
	Seven Lakes	35.5
	Upper Slide Lake	24.7
Medicine Bow	West Glacier	26.1
Rawah	Island Lake	64.6
	Rawah #4 Lake	41.2

#### 4.1 Other CALPUFF Inputs

In addition to the meteorological and emissions input data files described in Sections 2 and 3 and the receptor inputs described in subsection 4.1, CALPUFF also requires an ozone data input file. The ozone data input file used in the CD/WII/SB air quality modeling studies was also used for Desolation Flats analysis. This ozone data file contains data collected during the Mount Zirkel visibility study, and routinely collected at Yellowstone National Park, Craters of the Moon National Park, Pinedale, and Centennial NDDN sites. The ozone data file assigned a background ozone value to each computational grid cell in the modeling domain based on the nearest of the six ozone monitoring locations.

There are also several optional files that were not used, including (i.e., user-specified deposition velocity, chemical conversion rates, turbulence data, and isolated hill files). Defaults were used instead of user-supplied files. Some of the key options selected for the Desolation Flats CALPUFF modeling include:

- Gaussian near-field vertical distribution;
- No transitional plume rise;
- Stack tip downwash;
- PG dispersion coefficients (rural areas);
- No surface roughness adjustment to dispersion coefficients;
- Building downwash effects (ISC3 techniques), and
- Wet deposition, dry deposition, and chemical transformation were considered.

In addition, the current version of CALPUFF explicitly treats NO versus NO<sub>2</sub> emissions. Therefore, an NO versus NO<sub>2</sub> emission split was applied to the NOx emissions. The RIVAD/ARM3 chemical mechanism internally contained in the CALPUFF model was used. A background ammonia concentration of 1 ppb was assumed (per the CD/WII/SB studies) and a default background ozone concentration of 49 ppb was used when hourly ozone data were missing.

Eight species were modeled with five species being emitted. The modeled and emitted species are as follows:

- SO<sub>2</sub> (emitted)
- SO<sub>4</sub>
- NO (emitted)
- NO<sub>2</sub> (emitted)
- HNO<sub>3</sub>
- NO<sub>3</sub>
- PM<sub>10</sub> (emitted)
- PM<sub>2.5</sub> (emitted)

In order to keep run times reasonable and to evaluate the combination of emissions (project only, emission increases, and emission decreases) for both the near- and far-field, eleven CALPUFF runs were made for each of the 14 meteorological data periods (previously discussed in Subsection 2.2). The nine sets of CALPUFF runs were as follows (with a two-letter identifier used in the model runs noted in parentheses):

- Desolation Flats Project Sources Alone, Near-Field Domain (DP)
- Desolation Flats Project Sources Alone, Far-Field Domain (DR)
- Permitted Increases, Near-Field Domain (BP)
- Permitted Increases, Far-Field Domain (BR)
- Emission Decreases, Near-Field Domain (PP)
- Emission Decreases, Far-Field Domain (PR)
- RFD Sources, Near-Field Domain (NFTL)
- RFD Sources, Far-Field Domain (TL)
- Naughton Power Plant Emissions Reduction, Far-Field Domain (NR)

The output files from each of the above listed model runs were subsequently post-processed to obtain the necessary results.

## Exhibit 4-1 Example CALPUFF Control File

CALPUFF Modeling for Desolation Flats EIS -- January 1 - 31, 1995  
Project Sources Only (6 point sources, 15 area sources)  
Using CALMET Winds, 4km grid cells (125 x 100 grid); 413 Sensitive Receptors  
----- Run title (3 lines) -----

### CALPUFF MODEL CONTROL FILE

#### INPUT GROUP: 0 -- Input and Output File Names

-----  
Default Name Type File Name  
-----  
CALMET.DAT input ! METDAT =D:\DESQLATS\CALMET\CALMET01.DAT !  
or  
ISCMET.DAT input \* ISCDAT = \*  
or  
PLMMET.DAT input \* PLMDAT = \*  
or  
PROFILE.DAT input \* PRFDAT = \*  
SURFACE.DAT input \* SFCDAT = \*  
RESTARTB.DAT input \* RSTARTB= \*  
-----  
CALPUFF.LST output ! PUFLST =D:\DesFlats\CALPUFF\SENSREC\DR\PF01DR.LST !  
CONC.DAT output ! CONDAT =D:\DesFlats\CALPUFF\SENSREC\DR\CN01DR.DAT !  
DFLX.DAT output ! DFDAT =D:\DesFlats\CALPUFF\SENSREC\DR\DF01DR.DAT !  
WFLX.DAT output ! WFDAT =D:\DesFlats\CALPUFF\SENSREC\DR\WF01DR.DAT !  
-----  
VISB.DAT output \* VISDAT = \*  
RESTARTE.DAT output ! RSTARTE=D:\DesFlats\CALPUFF\SENSREC\DR\REE01DR.DAT !  
-----

#### Emission Files

-----  
PTEMARB.DAT input \* PTDAT = \*  
VOLEM.DAT input \* VOLDAT = \*  
BAEMARB.DAT input \* ARDAT = \*  
LNEMARB.DAT input \* LNDAT = \*  
-----

#### Other Files

-----  
OZONE.DAT input ! OZDAT =D:\DesFlats\CALPUFF\OZONE.DAT !  
VD.DAT input \* VDDAT = \*  
CHEM.DAT input \* CHEMDAT= \*  
HILL.DAT input \* HILDAT= \*  
HILLRCT.DAT input \* RCTDAT= \*  
DEBUG.DAT output \* DEBUG =DEBUG.DAT \*  
-----

All file names will be converted to lower case if LCFILES = T  
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE  
T = lower case ! LCFILES = T !  
F = UPPER CASE

NOTE: (1) file/path names can be up to 70 characters in length

!END!

-----  
INPUT GROUP: 1 -- General run control parameters  
-----

Option to run all periods found  
in the met. file(s) (METRUN) Default: 0 ! METRUN = 0 !

METRUN = 0 - Run period explicitly defined below  
METRUN = 1 - Run all periods in met. file(s)

Starting date: Year (IBYR) -- No default ! IBYR = 1995 !  
(used only if Month (IBMO) -- No default ! IBMO = 1 !  
METRUN = 0) Day (IBDY) -- No default ! IBDY = 1 !  
Hour (IBHR) -- No default ! IBHR = 0 !

Length of run (hours) (IRLG) -- No default ! IRLG = 744 !

Number of chemical species (NSPEC)  
Default: 5 ! NSPEC = 8 !

Number of chemical species  
to be emitted (NSE) Default: 3 ! NSE = 5 !

Flag to stop run after  
SETUP phase (ITEST) Default: 2 ! ITEST = 2 !  
(Used to allow checking  
of the model inputs, files, etc.)  
ITEST = 1 - STOPS program after SETUP phase  
ITEST = 2 - Continues with execution of program  
after SETUP

Restart Configuration:

Control flag (MRESTART) Default: 0 ! MRESTART = 2 !

0 = Do not read or write a restart file  
1 = Read a restart file at the beginning of  
the run  
2 = Write a restart file during run  
3 = Read a restart file at beginning of run  
and write a restart file during run

Number of periods in Restart  
output cycle (NRESPD) Default: 0 ! NRESPD = 0 !

0 = File written only at last period  
>0 = File updated every NRESPD periods

Meteorological Data Format (METFM)  
Default: 1 ! METFM = 1 !

METFM = 1 - CALMET binary file (CALMET.MET)  
METFM = 2 - ISC ASCII file (ISCMET.MET)  
METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)  
METFM = 4 - CTDM plus tower file (PROFILE.DAT) and  
surface parameters file (SURFACE.DAT)

Averaging Time (minutes) (AVET)  
Default: 60.0 ! AVET = 60. !  
PG sigma-y is adjusted by the equation  
(AVET/60.0)\*\*0.2

!END!

-----  
INPUT GROUP: 2 -- Technical options  
-----

Vertical distribution used in the  
near field (MGAUSS) Default: 1 ! MGAUSS = 1 !  
0 = uniform  
1 = Gaussian

Terrain adjustment method  
(MCTADJ) Default: 1 ! MCTADJ = 3 !  
0 = no adjustment  
1 = ISC-type of terrain adjustment  
2 = simple, CALPUFF-type of terrain  
adjustment  
3 = partial plume path adjustment

Subgrid-scale complex terrain  
flag (MCTSG) Default: 0 ! MCTSG = 0 !  
0 = not modeled  
1 = modeled

Near-field puffs modeled as  
elongated 0 (MSLUG) Default: 0 ! MSLUG = 0 !  
0 = no  
1 = yes (slug model used)

Transitional plume rise modeled ?  
(MTRANS) Default: 1 ! MTRANS = 0 !  
0 = no (i.e., final rise only)  
1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP) Default: 1 ! MTIP = 1 !  
0 = no (i.e., no stack tip downwash)  
1 = yes (i.e., use stack tip downwash)

Vertical wind shear modeled above  
stack top? (MSHEAR) Default: 0 ! MSHEAR = 0 !  
0 = no (i.e., vertical wind shear not modeled)  
1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT) Default: 0 ! MSPLIT = 0 !  
0 = no (i.e., puffs not split)  
1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM) Default: 1 ! MCHEM = 3 !  
0 = chemical transformation not

modeled  
1 = transformation rates computed  
internally (MESOPUFF II scheme)  
2 = user-specified transformation  
rates used  
3 = transformation rates computed  
internally (RIVAD/ARM3 scheme)

Wet removal modeled ? (MWET)      Default: 1 ! MWET = 1 !  
0 = no  
1 = yes

Dry deposition modeled ? (MDRY)      Default: 1 ! MDRY = 1 !  
0 = no  
1 = yes  
(dry deposition method specified  
for each species in Input Group 3)

Method used to compute dispersion  
coefficients (MDISP)      Default: 3 ! MDISP = 3 !

1 = dispersion coefficients computed from measured values  
of turbulence, sigma v, sigma w  
2 = dispersion coefficients from internally calculated  
sigma v, sigma w using micrometeorological variables  
(u\*, w\*, L, etc.)  
3 = PG dispersion coefficients for RURAL areas (computed using  
the ISCST multi-segment approximation) and MP coefficients in  
urban areas  
4 = same as 3 except PG coefficients computed using  
the MESOPUFF II eqns.  
5 = CTDM sigmas used for stable and neutral conditions.  
For unstable conditions, sigmas are computed as in  
MDISP = 3, described above. MDISP = 5 assumes that  
measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)  
(Used only if MDISP = 1 or 5)      Default: 3 ! MTURBVW = 0 !

1 = use sigma-v or sigma-theta measurements  
from PROFILE.DAT to compute sigma-y  
(valid for METFM = 1, 2, 3, 4)  
2 = use sigma-w measurements  
from PROFILE.DAT to compute sigma-z  
(valid for METFM = 1, 2, 3, 4)  
3 = use both sigma-(v/theta) and sigma-w  
from PROFILE.DAT to compute sigma-y and sigma-z  
(valid for METFM = 1, 2, 3, 4)  
4 = use sigma-theta measurements  
from PLMMET.DAT to compute sigma-y  
(valid only if METFM = 3)

Back-up method used to compute dispersion  
when measured turbulence data are  
missing (MDISP2)      Default: 3 ! MDISP2 = 4 !  
(used only if MDISP = 1 or 5)  
2 = dispersion coefficients from internally calculated  
sigma v, sigma w using micrometeorological variables  
(u\*, w\*, L, etc.)

3 = PG dispersion coefficients for RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients in urban areas

4 = same as 3 except PG coefficients computed using the MESOPUFF II eqns.

PG sigma-y,z adj. for roughness? Default: 0 ! MROUGH = 0 !

(MROUGH)

0 = no

1 = yes

Partial plume penetration of Default: 0 ! MPARTL = 0 !  
elevated inversion?

(MPARTL)

0 = no

1 = yes

Strength of temperature inversion Default: 0 ! MTINV = 0 !  
provided in PROFILE.DAT extended records?

(MTINV)

0 = no (computed from measured/default gradients)

1 = yes

PDF used for dispersion under convective conditions?  
Default: 0 ! MPDF = 0 !

(MPDF)

0 = no

1 = yes

Test options specified to see if  
they conform to regulatory  
values? (MREG) Default: 0 ! MREG = 0 !

0 = NO checks are made

1 = Technical options must conform to USEPA values for  
short-range modeling (e.g. ISC-type applications)

2 = Technical options must conform to USEPA values for  
long-range modeling (e.g. visibility-type applications)

3 = Other constraints

!END!

---

INPUT GROUP: 3a, 3b -- Species list

---

-----  
Subgroup (3a)  
-----

The following species are modeled:

! CSPEC = SO2 ! !END!  
! CSPEC = SO4 ! !END!  
! CSPEC = NO ! !END!

```

! CSPEC = NO2 ! !END!
! CSPEC = HNO3 ! !END!
! CSPEC = NO3 ! !END!
! CSPEC = PM10 ! !END!
! CSPEC = PM25 ! !END!

```

SPECIES NAME (Limit: 12 Characters in length)	Dry			OUTPUT GROUP (0=NONE, 1=COMPUTED-GAS 2=COMPUTED-PARTICLE 3=USER-SPECIFIED) NUMBER 1=1st CGRUP, 2=2nd CGRUP, 3= etc.)
	MODELED (0=NO, 1=YES)	EMITTED (0=NO, 1=YES)	DEPOSITED (0=NO,	

```

! SO2 = 1, 1, 1, 0 !
! SO4 = 1, 0, 2, 0 !
! NO = 1, 1, 1, 0 !
! NO2 = 1, 1, 1, 0 !
! HNO3 = 1, 0, 1, 0 !
! NO3 = 1, 0, 2, 0 !
! PM10 = 1, 1, 2, 0 !
! PM25 = 1, 1, 2, 0 !

```

!END!

---

#### Subgroup (3b)

---

The following names are used for Species-Groups in which results for certain species are combined (added) prior to output. The CGRUP name will be used as the species name in output files. Use this feature to model specific particle-size distributions by treating each size-range as a separate species. Order must be consistent with 3(a) above.

---

#### INPUT GROUP: 4 -- Grid control parameters

---

##### METEOROLOGICAL grid:

```

No. X grid cells (NX) No default ! NX = 125 !
No. Y grid cells (NY) No default ! NY = 100 !
No. vertical layers (NZ) No default ! NZ = 10 !

```

```

Grid spacing (DGRIDKM) No default ! DGRIDKM = 4. !
Units: km

```

```

Cell face heights
(ZFACE(nz+1)) No defaults
Units: m
! ZFACE = 0., 20., 40., 80., 160., 300., 600., 1000., 1500., 2200., 3000. !

```

Reference Coordinates  
of SOUTHWEST corner of  
grid cell(1, 1):

X coordinate (XORIGKM) No default ! XORIGKM = -230. !  
Y coordinate (YORIGKM) No default ! YORIGKM = -258. !  
Units: km  
  
UTM zone (IUTMZN) No default ! IUTMZN = 12 !

Reference coordinates of CENTER  
of the domain (used in the  
calculation of solar elevation  
angles)

Latitude (deg.) (XLAT) No default ! XLAT = 42.55 !  
Longitude (deg.) (XLONG) No default ! XLONG = 108.55 !  
Time zone (XTZ) No default ! XTZ = 7.0 !  
(PST=8, MST=7, CST=6, EST=5)

Computational grid:

The computational grid is identical to or a subset of the MET. grid.  
The lower left (LL) corner of the computational grid is at grid point  
(IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the  
computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.  
The grid spacing of the computational grid is the same as the MET. grid.

X index of LL corner (IBCOMP) No default ! IBCOMP = 1 !  
(1 <= IBCOMP <= NX)

Y index of LL corner (JBCOMP) No default ! JBCOMP = 1 !  
(1 <= JBCOMP <= NY)

X index of UR corner (IECOMP) No default ! IECOMP = 125 !  
(1 <= IECOMP <= NX)

Y index of UR corner (JECOMP) No default ! JECOMP = 100 !  
(1 <= JECOMP <= NY)

SAMPLING GRID (GRIDDED RECEPTORS):

The lower left (LL) corner of the sampling grid is at grid point  
(IBSAMP, JBSAMP) of the MET. grid. The upper right (UR) corner of the  
sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.  
The sampling grid must be identical to or a subset of the computational  
grid. It may be a nested grid inside the computational grid.  
The grid spacing of the sampling grid is DGRIDKM/MESHDN.

Logical flag indicating if gridded  
receptors are used (LSAMP) Default: T ! LSAMP = F !  
(T=yes, F=no)

X index of LL corner (IBSAMP) No default ! IBSAMP = 0 !

(IBCOMP <= IBSAMP <= IECOMP)

Y index of LL corner (JBSAMP) No default ! JBSAMP = 0 !  
(JBCOMP <= JBSAMP <= JECOMP)

X index of UR corner (IESAMP) No default ! IESAMP = 0 !  
(IBCOMP <= IESAMP <= IECOMP)

Y index of UR corner (JESAMP) No default ! JESAMP = 0 !  
(JBCOMP <= JESAMP <= JECOMP)

Nesting factor of the sampling  
grid (MESHDN) Default: 1 ! MESHDN = 1 !  
(MESHDN is an integer >= 1)

!END!

---

#### INPUT GROUP: 5 -- Output Options

---

FILE	DEFAULT VALUE	VALUE THIS RUN
Concentrations (ICON)	1	! ICON = 1 !
Dry Fluxes (IDRY)	1	! IDRY = 1 !
Wet Fluxes (IWET)	1	! IWET = 1 !
Relative Humidity (IVIS)	1	! IVIS = 0 !
(relative humidity file is required for visibility analysis)		
Use data compression option in output file?		
(LCOMPRS)	Default: T	! LCOMPRS = T !
*		
0 = Do not create file, 1 = create file		

#### LINE PRINTER OUTPUT OPTIONS:

Print concentrations (ICPRT) Default: 0 ! ICPRT = 0 !  
Print dry fluxes (IDPRT) Default: 0 ! IDPRT = 0 !  
Print wet fluxes (IWPRT) Default: 0 ! IWPRT = 0 !  
(0 = Do not print, 1 = Print)

Concentration print interval  
(ICFRQ) in hours Default: 1 ! ICFRQ = 1 !  
Dry flux print interval  
(IDFRQ) in hours Default: 1 ! IDFRQ = 1 !  
Wet flux print interval  
(IWFRQ) in hours Default: 1 ! IWFRQ = 1 !

Units for Line Printer Output  
(IPRTU) Default: 1 ! IPRTU = 3 !

for for  
 Concentration Deposition  
 1 = g/m\*\*3 g/m\*\*2/s  
 2 = mg/m\*\*3 mg/m\*\*2/s  
 3 = ug/m\*\*3 ug/m\*\*2/s  
 4 = ng/m\*\*3 ng/m\*\*2/s  
 5 = Odour Units

Messages tracking progress of Default: 1 ! IMESG = 1 !  
 run written to the screen ?  
 (IMESG) -- 0=no, 1=yes

#### SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

----- CONCENTRATIONS -----			----- DRY FLUXES -----			----- WET FLUXES -----		
SPECIES /GROUP	PRINTED ?	SAVED ON DISK ?	PRINTED ?	SAVED ON DISK ?	PRINTED ?	SAVED ON DISK ?	PRINTED ?	SAVED ON DISK ?
?								
! SO2 = 0,	1,	0,	1,	0,	1 !			
! SO4 = 0,	1,	0,	1,	0,	1 !			
! NO = 0,	1,	0,	1,	0,	1 !			
! NO2 = 0,	1,	0,	1,	0,	1 !			
! HNO3 = 0,	1,	0,	1,	0,	1 !			
! NO3 = 0,	1,	0,	1,	0,	1 !			
! PM10 = 0,	1,	0,	1,	0,	1 !			
! PM25 = 0,	1,	0,	1,	0,	1 !			

#### OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

Logical for debug output  
(LDEBUG) Default: F ! LDEBUG = F !

Number of puffs to track  
(NPFDDEB) Default: 1 ! NPFDDEB = 1 !

Met. period to start output  
(NN1) Default: 1 ! NN1 = 1 !

Met. period to end output  
(NN2) Default: 10 ! NN2 = 10 !

!END!

---

#### INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs

---



---

##### Subgroup (6a)

---

Number of terrain features (NHILL) Default: 0 ! NHILL = 0 !

Number of special complex terrain

receptors (NCTREC) Default: 0 ! NCTREC = 0 !

Terrain and CTSG Receptor data for  
CTSG hills input in CTDM format ?  
(MHILL) No Default ! MHILL = 0 !

1 = Hill and Receptor data created  
by CTDM processors & read from  
HILL.DAT and HILLRCT.DAT files  
2 = Hill data created by OPTHILL &  
input below in Subgroup (6b);  
Receptor data in Subgroup (6c)

Factor to convert horizontal dimensions Default: 1.0 ! XHILL2M = 1. !  
to meters (MHILL=1)

Factor to convert vertical dimensions Default: 1.0 ! ZHILL2M = 1. !  
to meters (MHILL=1)

X-origin of CTDM system relative to No Default ! XCTDMKM = 0.0E00 !  
CALPUFF coordinate system, in Kilometers (MHILL=1)

Y-origin of CTDM system relative to No Default ! YCTDMKM = 0.0E00 !  
CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

-----  
Subgroup (6b)  
-----

1 \*\*  
HILL information

HILL NO.	XC (km)	YC (km)	THETAH (deg.)	ZGRID (m)	RELIEF (m)	EXPO 1 (m)	EXPO 2 (m)	SCALE 1 (m)	SCALE 2 (m)	AMAX1	AMAX2
---	---	---	---	---	---	---	---	---	---	---	---

-----  
Subgroup (6c)  
-----

COMPLEX TERRAIN RECEPTOR INFORMATION

XRCT (km)	YRCT (km)	ZRCT (m)	XHH
---	---	---	---

1

Description of Complex Terrain Variables:  
XC, YC = Coordinates of center of hill  
THETAH = Orientation of major axis of hill (clockwise from  
North)  
ZGRID = Height of the 0 of the grid above mean sea  
level  
RELIEF = Height of the crest of the hill above the grid elevation

EXPO 1 = Hill-shape exponent for the major axis  
 EXPO 2 = Hill-shape exponent for the major axis  
 SCALE 1 = Horizontal length scale along the major axis  
 SCALE 2 = Horizontal length scale along the minor axis  
 AMAX = Maximum allowed axis length for the major axis  
 BMAX = Maximum allowed axis length for the major axis

XRCT, YRCT = Coordinates of the complex terrain receptors  
 ZRCT = Height of the ground (MSL) at the complex terrain  
 Receptor  
 XHH = Hill number associated with each complex terrain receptor  
 (NOTE: MUST BE ENTERED AS A REAL NUMBER)

\*\*

NOTE: DATA for each hill and CTSG receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

-----  
INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases

SPECIES COEFFICIENT	DIFFUSIVITY	ALPHA STAR	REACTIVITY	MESOPHYLL RESISTANCE	HENRY'S LAW
NAME	(cm**2/s)		(s/cm)		(dimensionless)
! SO2 =	0.1509,	1000.,	8.,	0.,	4.0E-2 !
! NO =	0.1345,	1.,	2.,	25.,	18. !
! NO2 =	0.1656,	1.,	8.,	5.,	3.5 !
! HNO3 =	0.1628,	1.,	180.,	0.,	8.0E-8 !

!END!

-----  
INPUT GROUP: 8 -- Size parameters for dry deposition of particles

For SINGLE SPECIES, the mean and standard deviation are used to compute a deposition velocity for NINT (see group 9) size-ranges, and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly specified (by the 'species' in the group), and the standard deviation for each should be entered as 0. The model will then use the deposition velocity for the stated mean diameter.

SPECIES	GEOMETRIC MASS MEAN	GEOMETRIC STANDARD
NAME	DIAMETER	DEVIATION
	(microns)	(microns)
! SO4 =	0.48,	2.0 !
! NO3 =	0.48,	2.0 !
! PM10 =	10.0,	0.0 !

! PM25 = 2.5, 0.0 !

!END!

---

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters

---

Reference cuticle resistance (RCUTR) (s/cm) ! RCUTR = 30. !  
Reference ground resistance (RGR) (s/cm) ! RGR = 5. !  
Reference pollutant reactivity (REACTR) ! REACTR = 8. !

Number of particle-size intervals used to  
evaluate effective particle deposition velocity  
(NINT) Default: 9 ! NINT = 9 !

Vegetation state in unirrigated areas (IVEG) ! IVEG = 1 !  
IVEG=1 for active and unstressed vegetation  
IVEG=2 for active and stressed vegetation  
IVEG=3 for inactive vegetation

!END!

---

INPUT GROUP: 10 -- Wet Deposition Parameters

---

Scavenging Coefficient -- Units: (sec)\*\*(-1)

Pollutant	Liquid Precip.	Frozen Precip.
! SO2	= 3.0E-5 , 0.0 !	
! SO4	= 10.0E-5 , 3.0E-5 !	
! NO	= 0.0 , 0.0 !	
! NO2	= 0.0 , 0.0 !	
! HNO3	= 6.0E-5 , 0.0 !	
! NO3	= 10.0E-5 , 3.0E-5 !	
! PM10	= 10.0E-5 , 3.0E-5 !	
! PM25	= 10.0E-5 , 3.0E-5 !	

!END!

---

INPUT GROUP: 11 -- Chemistry Parameters

---

Ozone data input option (MOZ) Default: 1 ! MOZ = 1 !  
(Used only if MCHEM = 1 or 3)

0 = use a constant background ozone value  
1 = read hourly ozone concentrations from  
the OZONE.DAT data file

Background ozone concentration  
(BCKO3) in ppb                  Default: 80.                  ! BCKO3 = 49. !  
(Used only if MCHEM = 1 or 3 and  
MOZ = 0 or (MOZ = 1 and all hourly  
O3 data missing)

Background ammonia concentration  
(BCKNH3) in ppb                  Default: 10.                  ! BCKNH3 = 1. !

Nighttime SO2 loss rate (RNITE1)  
in percent/hour                  Default: 0.2                  ! RNITE1 = 0.2 !

Nighttime NOx loss rate (RNITE2)  
in percent/hour                  Default: 2.0                  ! RNITE2 = 2. !

Nighttime HNO3 formation rate (RNITE3)  
in percent/hour                  Default: 2.0                  ! RNITE3 = 2. !

!END!

---

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters

---

Horizontal size of puff (m) beyond which  
time-dependent dispersion equations (Heffter)  
are used to determine sigma-y and  
sigma-z (SYTDEP)                  Default: 550.                  ! SYTDEP = 5.5E02 !

Switch for using Heffter equation for sigma z  
as above (0 = Not use Heffter; 1 = use Heffter  
(MHFTSZ)                  Default: 0                  ! MHFTSZ = 0 !

Stability class used to determine plume  
growth rates for puffs above the boundary  
layer (JSUP)                  Default: 5                  ! JSUP = 5 !

Vertical dispersion constant for stable  
conditions (k1 in Eqn. 2.7-3) (CONK1)                  Default: 0.01                  ! CONK1 = 0.01 !

Vertical dispersion constant for neutral/  
unstable conditions (k2 in Eqn. 2.7-4)  
(CONK2)                  Default: 0.1                  ! CONK2 = 0.1 !

Factor for determining Transition-point from  
Schulman-Scire to Huber-Snyder Building Downwash  
scheme (SS used for Hs < Hb + TBD \* HL)  
(TBD)                  Default: 0.5                  ! TBD = 0.5 !  
TBD < 0 ==> always use Huber-Snyder  
TBD = 1.5 ==> always use Schulman-Scire  
TBD = 0.5 ==> ISC Transition-point

Range of land use categories for which urban dispersion is assumed  
**(IURB1, IURB2)** Default: 10 ! IURB1 = 10 !  
19 ! IURB2 = 19 !

Site characterization parameters for single-point Met data files -----  
(needed for METFM = 2,3,4)

Land use category for modeling domain  
**(ILANDUIN)** Default: 20 ! ILANDUIN = 20

Roughness length (m) for modeling domain  
**(Z0IN)** Default: 0.25 ! Z0IN = 0.25 !

Leaf area index for modeling domain  
**(XLAIIN)** Default: 3.0 ! XLAIIN = 3. !

Specialized information for interpreting single-point Met data files ---

Anemometer height (m) (Used only if METFM = 2,3)  
**(ANEMHT)** Default: 10. ! ANEMHT = 10. !

Form of lateral turbulence data in PROFILE.DAT file  
(Used only if METFM = 4 or MTURBVW = 1 or 3)  
**(ISIGMAV)** Default: 1 ! ISIGMAV = 2 !  
0 = read sigma-theta  
1 = read sigma-v

Choice of mixing heights (Used only if METFM = 4)  
**(IMIXCTDM)** Default: 0 ! IMIXCTDM = 0  
0 = read PREDICTED mixing heights  
1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units)  
**(XMXLEN)** Default: 1.0 ! XMXLEN = 1. !

Maximum travel distance of a puff/slug (in grid units) during one sampling step  
**(XSAMLEN)** Default: 1.0 ! XSAMLEN = 1. !

Maximum Number of slugs/puffs release from one source during one time step  
**(MXNEW)** Default: 99 ! MXNEW = 99 !

Maximum Number of sampling steps for one puff/slug during one time step  
**(MXSAM)** Default: 99 ! MXSAM = 99 !

Minimum sigma y for a new puff/slug (m)  
**(SYMIN)** Default: 1.0 ! SYMIN = 1.0 !

Minimum sigma z for a new puff/slug (m)  
**(SZMIN)** Default: 1.0 ! SZMIN = 1.0 !

Default minimum turbulence velocities  
sigma-v and sigma-w for each  
stability class (m/s)  
**(SVMIN(6) and SWMIN(6))** Default SVMIN : .50, .50, .50, .50,

Default SWMIN : .20, .12, .08, .06, .03, .016

Stability Class : A B C D E F

--- --- --- --- ---  
! SVMIN = .50, .50, .50, .50, .50 !  
! SWMIN = .20, .12, .08, .06, .03, .016 !

Divergence criterion for dw/dz in met cell  
used to initiate adjustment for horizontal  
convergence (1/s)

(CDIV) Default: 0.010 ! CDIV = 0.01 !

Minimum wind speed (m/s) allowed for  
non-calm conditions. Also used as minimum  
speed returned when using power-law  
extrapolation toward surface

(WSCALM) Default: 1.0 ! WSCALM = 0.5 !

Maximum mixing height (m)  
(XMAXZI) Default: 3000. ! XMAXZI = 3000. !

Minimum mixing height (m)  
(XMINZI) Default: 50. ! XMINZI = 20. !

Default wind speed classes --  
5 upper bounds (m/s) are entered;  
the 6th class has no upper limit  
(WSCAT(5)) Default :  
ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8 (10.8+)

Wind Speed Class : 1 2 3 4 5 6  
--- --- --- --- ---  
! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

Default wind speed profile power-law  
exponents for stabilities 1-6  
(PLX0(6)) Default : ISC RURAL values  
ISC RURAL : .07, .07, .10, .15, .35, .55  
ISC URBAN : .15, .15, .20, .25, .30, .30

Stability Class : A B C D E F  
--- --- --- --- ---  
! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35, 0.55 !

Default potential temperature gradient  
for stable classes E, F (degK/m)  
(PTG0(2)) Default: 0.020, 0.035  
! PTG0 = 0.020, 0.035 !

Default plume path coefficients for  
each stability class (used when option  
for partial plume height terrain adjustment  
is selected -- MCTADJ=3)  
(PPC(6)) Stability Class : A B C D E F  
Default PPC : .50, .50, .50, .50, .35, .35  
--- --- --- --- ---  
! PPC = 0.50, 0.50, 0.50, 0.50, 0.35, 0.35 !

Slug-to-puff transition criterion factor  
equal to sigma-y/length of slug  
(SL2PF) Default: 10. ! SL2PF = 10. !

Puff-splitting control variables -----

Number of puffs that result every time a puff  
is split - nsplit=2 means that 1 puff splits  
into 2  
(NSPLIT) Default: 3 ! NSPLIT = 3 !

Time(s) of a day when split puffs are eligible to  
be split once again; this is typically set once  
per day, around sunset before nocturnal shear develops.  
24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)  
0=do not re-split 1=eligible for re-split  
(IRESPLIT(24)) Default: Hour 17 = 1  
! IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

Split is allowed only if last hour's mixing  
height (m) exceeds a minimum value  
(ZISPLIT) Default: 100. ! ZISPLIT = 100. !

Split is allowed only if ratio of last hour's  
mixing ht to the maximum mixing ht experienced  
by the puff is less than a maximum value (this  
postpones a split until a nocturnal layer develops)  
(ROLDMAX) Default: 0.25 ! ROLDMAX = 0.25 !

Integration control variables -----

Fractional convergence criterion for numerical SLUG  
sampling integration  
(EPSSLUG) Default: 1.0e-04 ! EPSSLUG = 1.0E-04 !

Fractional convergence criterion for numerical AREA  
source integration  
(EPSAREA) Default: 1.0e-06 ! EPSAREA = 1.0E-06 !

!END!

-----  
INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters  
-----

-----  
Subgroup (13a)  
-----

Number of point sources with  
parameters provided below (NPT1) No default ! NPT1 = 6 !

Units used for point source  
emissions below (IPTU) Default: 1 ! IPTU = 1 !

1 = g/s  
 2 = kg/hr  
 3 = lb/hr  
 4 = tons/yr  
 5 = Odour Unit \* m\*\*3/s (vol. flux of odour compound)  
 6 = Odour Unit \* m\*\*3/min

Number of source-species  
 combinations with variable  
 emissions scaling factors  
 provided below in (13d) (NSPT1) Default: 0 ! NSPT1 = 0 !

Number of point sources with  
 variable emission parameters  
 provided in external file (NPT2) No default ! NPT2 = 0 !

(If NPT2 > 0, these point  
 source emissions are read from  
 the file: PTEMARB.DAT)

!END!

-----  
 Subgroup (13b)

a  
 POINT SOURCE: CONSTANT DATA  
 -----

Source No.	X UTM	Y UTM	Stack Coordinate	Base Coordinate	Stack Height	Exit Diameter	Exit Elevation	Bldg. Vel.	Temp.	Dwash	Emission Rates
	(km)	(km)	(m)	(m)	(m)	(m)	(deg.)	(m/s)	(K)		
1 ! SRCNAM = GP_1 !											
! X = 42.79, -157.60, 9.30, 2000.0, 0.305, 45.0, 800.0, 1., 0.00, 0.00, 1.42, 0.24, 0.0, 0.0, 0.04, 0.04 !											
! FMFAC = 1.0 !,! END !											
2 ! SRCNAM = GP_2 !											
! X = 34.68, -128.04, 9.30, 2000.0, 0.305, 45.0, 800.0, 1., 0.00, 0.00, 1.42, 0.24, 0.0, 0.0, 0.04, 0.04 !											
! FMFAC = 1.0 !,! END !											
3 ! SRCNAM = CMP_1 !											
! X = 42.20, -130.88, 9.30, 2000.0, 0.305, 45.0, 800.0, 1., 0.00, 0.00, 1.19, 0.20, 0.0, 0.0, 0.03, 0.03 !											
! FMFAC = 1.0 !,! END !											
4 ! SRCNAM = CMP_2 !											
! X = 48.79, -136.62, 9.30, 2000.0, 0.305, 45.0, 800.0, 1., 0.00, 0.00, 1.19, 0.20, 0.0, 0.0, 0.03, 0.03 !											
! FMFAC = 1.0 !,! END !											
5 ! SRCNAM = CMP_3 !											
! X = 42.41, -143.55, 9.30, 2000.0, 0.305, 45.0, 800.0, 1., 0.00, 0.00, 1.19, 0.20, 0.0, 0.0, 0.03, 0.03 !											
! FMFAC = 1.0 !,! END !											
6 ! SRCNAM = CMP_4 !											
! X = 35.43, -147.96, 9.30, 2000.0, 0.305, 45.0, 800.0, 1., 0.00, 0.00, 1.19, 0.20, 0.0, 0.0, 0.03, 0.03 !											
! FMFAC = 1.0 !,! END !											

-----  
 a

Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

b

0. = No building downwash modeled, 1. = downwash modeled  
NOTE: must be entered as a REAL number (i.e., with decimal point)

c

An emission rate must be entered for every pollutant modeled.  
Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IPTU (e.g. 1 for g/s).

-----  
Subgroup (13c)  
-----

#### BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH

Source   a  
No.     Effective building width and height (in meters) every 10 degrees

```
1 !SRCNAM = GP_1 !
1 !HEIGHT = 6.10, 6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10!
1 !WIDTH = 9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
         13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
         13.63, 13.28, 12.53, 11.39, 9.91, 8.13,
         9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
         13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
         13.63, 13.28, 12.53, 11.39, 9.91, 8.13!
!END!
2 !SRCNAM = GP_2 !
2 !HEIGHT = 6.10, 6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10!
2 !WIDTH = 9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
         13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
         13.63, 13.28, 12.53, 11.39, 9.91, 8.13,
         9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
         13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
         13.63, 13.28, 12.53, 11.39, 9.91, 8.13!
!END!
3 !SRCNAM = CMP_1 !
3 !HEIGHT = 6.10, 6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10,
         6.10, 6.10, 6.10, 6.10, 6.10!
```

```

3 ! WIDTH = 9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13,
    9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13!
!END!
4 ! SRCNAM = CMP_2 !
4 ! HEIGHT = 6.10, 6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10!
4 ! WIDTH = 9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13,
    9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13!
!END!
5 ! SRCNAM = CMP_3 !
5 ! HEIGHT = 6.10, 6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10!
5 ! WIDTH = 9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13,
    9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13!
!END!
6 ! SRCNAM = CMP_4 !
6 ! HEIGHT = 6.10, 6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10,
    6.10, 6.10, 6.10, 6.10, 6.10!
6 ! WIDTH = 9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13,
    9.91, 11.39, 12.53, 13.28, 13.63, 13.57,
    13.09, 12.22, 10.97, 12.22, 13.09, 13.57,
    13.63, 13.28, 12.53, 11.39, 9.91, 8.13!
!END!
-----
```

a

Each pair of width and height values is treated as a separate input subgroup and therefore must end with an input group terminator.

-----  
Subgroup (13d)  
-----

a  
POINT SOURCE: VARIABLE EMISSIONS DATA  
-----

Use this subgroup to describe temporal variations in the emission rates given in 13b. Factors entered multiply the rates in 13b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

IVARY determines the type of variation, and is source-specific:  
(IVARY) Default: 0

- 0 = Constant
- 1 = Diurnal cycle (24 scaling factors: hours 1-24)
- 2 = Monthly cycle (12 scaling factors: months 1-12)
- 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
- 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12)
- 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

-----  
a

Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

-----  
INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters  
-----

-----  
Subgroup (14a)  
-----

Number of polygon area sources with parameters specified below (NAR1) No default ! NAR1 = 15 !

Units used for area source emissions below (IARU) Default: 1 ! IARU = 1 !  
1 = g/m\*\*2/s  
2 = kg/m\*\*2/hr

3 = lb/m\*\*2/hr  
 4 = tons/m\*\*2/yr  
 5 = Odour Unit \* m/s (vol. flux/m\*\*2 of odour compound)  
 6 = Odour Unit \* m/min

Number of source-species  
 combinations with variable  
 emissions scaling factors  
 provided below in (14d) (NSAR1) Default: 0 ! NSAR1 = 12 !

Number of buoyant polygon area sources  
 with variable location and emission  
 parameters (NAR2) No default ! NAR2 = 0 !  
 (If NAR2 > 0, ALL parameter data for  
 these sources are read from the file: BAEMARB.DAT)

!END!

-----  
 Subgroup (14b)  
 -----

a

AREA SOURCE: CONSTANT DATA

-----  
 b

Source No.	Effect. Height (m)	Base Elevation (m)	Initial Sigma z (m)	Emission Rates
				SO2, SO4 NO NO2 HNO3, NO3, PM10, PM2.5
1! SRCNAM = WIND_1!	2.0,	2000.0,	1.0,	6*0.0, 1.04E-09, 4.17E-10 ! !END!
2! SRCNAM = WIND_2!	2.0,	2000.0,	1.0,	6*0.0, 1.71E-10, 6.85E-11 ! !END!
3! SRCNAM = WIND_3!	2.0,	2000.0,	1.0,	6*0.0, 3.43E-10, 1.37E-10 ! !END!
4! SRCNAM = RIG_1!	25.6,	2000.0,	11.9,	2.60E-10, 0.0, 1.32E-08, 2.25E-09, 2*0.0, 3.68E-10, 3.08E-10 ! !END!
5! SRCNAM = RIG_2!	25.6,	2000.0,	11.9,	4.27E-11, 0.0, 2.16E-09, 3.70E-10, 2*0.0, 6.04E-11, 5.05E-11 ! !END!
6! SRCNAM = RIG_3!	25.6,	2000.0,	11.9,	8.53E-11, 0.0, 4.32E-09, 7.39E-10, 2*0.0, 1.21E-10, 1.01E-10 ! !END!
7! SRCNAM = FLARE_1!	22.0,	2000.0,	10.2,	0.0, 7.35E-11, 1.25E-11, 2*0.0, 9.26E-12, 9.26E-12 ! !END!
8! SRCNAM = FLARE_2!	22.0,	2000.0,	10.2,	0.0, 1.20E-11, 2.06E-12, 2*0.0, 1.52E-12, 1.52E-12 ! !END!
9! SRCNAM = FLARE_3!	22.0,	2000.0,	10.2,	0.0, 2.41E-11, 4.12E-12, 2*0.0, 3.04E-12, 3.04E-12 ! !END!
10! SRCNAM = HTR_1!	20.7,	2000.0,	9.6,	0.0, 7.67E-10, 1.31E-10, 2*0.0, 6.93E-11, 6.93E-11 ! !END!
11! SRCNAM = HTR_2!	20.7,	2000.0,	9.6,	0.0, 1.26E-10, 2.15E-11, 2*0.0, 1.14E-11, 1.14E-11 ! !END!
12! SRCNAM = HTR_3!	20.7,	2000.0,	9.6,	0.0, 2.25E-10, 4.31E-11, 2*0.0, 2.28E-11, 2.28E-11 ! !END!
13! SRCNAM = FUG_TP_1!	2.0,	2000.0,	1.0,	3.96E-12, 0.0, 8.46E-11, 1.45E-11, 2*0.0, 4.46E-09, 6.64E-10 ! !END!
14! SRCNAM = FUG_TP_2!	2.0,	2000.0,	1.0,	6.50E-13, 0.0, 1.39E-11, 2.37E-12, 2*0.0, 7.33E-10, 1.09E-10 ! !END!
15! SRCNAM = FUG_TP_3!	2.0,	2000.0,	1.0,	1.30E-12, 0.0, 2.78E-11, 4.75E-12, 2*0.0, 1.47E-09, 2.18E-10 ! !END!

-----  
a

Data for each source are treated as a separate input subgroup  
and therefore must end with an input group terminator.

b

An emission rate must be entered for every pollutant modeled.  
Enter emission rate of zero for secondary pollutants that are  
modeled, but not emitted. Units are specified by IARU  
(e.g. 1 for g/m\*\*2/s).

-----  
Subgroup (14c)  
-----

COORDINATES (UTM-km) FOR EACH VERTEX(4) OF EACH POLYGON

Source a  
No. Ordered list of X followed by list of Y, grouped by source  
----- -----

```
! SRCNAM = WIND_1!
1 !XVERT = 23.4, 51.4, 51.4, 37.0 !
1 !YVERT = -161.6, -161.6, -133.4, -133.4 !
!END!
! SRCNAM = WIND_2!
2 !XVERT = 51.4, 56.5, 56.5, 51.4 !
2 !YVERT = -152.0, -152.0, -133.4, -133.4 !
!END!
3! SRCNAM = WIND_3!
3 !XVERT = 28.1, 48.1, 48.1, 28.1 !
3 !YVERT = -133.4, -133.4, -123.5, -123.5 !
!END!
4! SRCNAM = RIG_1!
4 !XVERT = 23.4, 51.4, 51.4, 37.0 !
4 !YVERT = -161.6, -161.6, -133.4, -133.4 !
!END!
5! SRCNAM = RIG_2!
5 !XVERT = 51.4, 56.5, 56.5, 51.4 !
5 !YVERT = -152.0, -152.0, -133.4, -133.4 !
!END!
6! SRCNAM = RIG_3!
6 !XVERT = 28.1, 48.1, 48.1, 28.1 !
6 !YVERT = -133.4, -133.4, -123.5, -123.5 !
!END!
7! SRCNAM = FLARE_1!
7 !XVERT = 23.4, 51.4, 51.4, 37.0 !
7 !YVERT = -161.6, -161.6, -133.4, -133.4 !
!END!
8! SRCNAM = FLARE_2!
8 !XVERT = 51.4, 56.5, 56.5, 51.4 !
8 !YVERT = -152.0, -152.0, -133.4, -133.4 !
!END!
9! SRCNAM = FLARE_3!
9 !XVERT = 28.1, 48.1, 48.1, 28.1 !
9 !YVERT = -133.4, -133.4, -123.5, -123.5 !
!END!
10! SRCNAM = HTR_1!
```

```

10 ! XVERT = 23.4, 51.4, 51.4, 37.0 !
10 ! YVERT = -161.6, -161.6, -133.4, -133.4 !
!END!
11! SRCNAM = HTR_2!
11 ! XVERT = 51.4, 56.5, 56.5, 51.4 !
11 ! YVERT = -152.0, -152.0, -133.4, -133.4 !
!END!
12! SRCNAM = HTR_3!
12 ! XVERT = 28.1, 48.1, 48.1, 28.1 !
12 ! YVERT = -133.4, -133.4, -123.5, -123.5 !
!END!
13! SRCNAM = FUG_TP_1!
13 ! XVERT = 23.4, 51.4, 51.4, 37.0 !
13 ! YVERT = -161.6, -161.6, -133.4, -133.4 !
!END!
14! SRCNAM = FUG_TP_2!
14 ! XVERT = 51.4, 56.5, 56.5, 51.4 !
14 ! YVERT = -152.0, -152.0, -133.4, -133.4 !
!END!
15! SRCNAM = FUG_TP_3!
15 ! XVERT = 28.1, 48.1, 48.1, 28.1 !
15 ! YVERT = -133.4, -133.4, -123.5, -123.5 !
!END!

```

-----  
a

Data for each source are treated as a separate input subgroup  
and therefore must end with an input group terminator.

-----  
Subgroup (14d)  
-----

a  
AREA SOURCE: VARIABLE EMISSIONS DATA  
-----

Use this subgroup to describe temporal variations in the emission  
rates given in 14b. Factors entered multiply the rates in 14b.  
Skip sources here that have constant emissions. For more elaborate  
variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

IVARY determines the type of variation, and is source-specific:

(IVARY) Default: 0

- 0 = Constant
- 1 = Diurnal cycle (24 scaling factors: hours 1-24)
- 2 = Monthly cycle (12 scaling factors: months 1-12)
- 3 = Hour & Season (4 groups of 24 hourly scaling factors,  
where first group is DEC-JAN-FEB)
- 4 = Speed & Stab. (6 groups of 6 scaling factors, where  
first group is Stability Class A,  
and the speed classes have upper  
bounds (m/s) defined in Group 12)
- 5 = Temperature (12 scaling factors, where temperature  
classes have upper bounds (C) of:  
0, 5, 10, 15, 20, 25, 30, 35, 40,  
45, 50, 50+)

```

10 ! SRCNAM = HTR_1!
! IVARY = 2 !
! NO = 1.72, 1.72, 1.72, 1.72, 0.28, 0.28,
0.28, 0.28, 0.28, 0.28, 1.72, 1.72 !
!END!
10 ! SRCNAM = HTR_1!
! IVARY = 2 !
! NO2 = 1.72, 1.72, 1.72, 1.72, 0.28, 0.28,
0.28, 0.28, 0.28, 0.28, 1.72, 1.72 !
!END!
11 ! SRCNAM = HTR_2!
! IVARY = 2 !
! NO = 1.72, 1.72, 1.72, 1.72, 0.28, 0.28,
0.28, 0.28, 0.28, 0.28, 1.72, 1.72 !
!END!
11 ! SRCNAM = HTR_2!
! IVARY = 2 !
! NO2 = 1.72, 1.72, 1.72, 1.72, 0.28, 0.28,
0.28, 0.28, 0.28, 0.28, 1.72, 1.72 !
!END!
12 ! SRCNAM = HTR_3!
! IVARY = 2 !
! NO = 1.72, 1.72, 1.72, 1.72, 0.28, 0.28,
0.28, 0.28, 0.28, 0.28, 1.72, 1.72 !
!END!
12 ! SRCNAM = HTR_3!
! IVARY = 2 !
! NO2 = 1.72, 1.72, 1.72, 1.72, 0.28, 0.28,
0.28, 0.28, 0.28, 0.28, 1.72, 1.72 !
!END!
13 ! SRCNAM = FUG_TP_1!
! IVARY = 1 !
! PM10 = 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0,
1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0 !
!END!
13 ! SRCNAM = FUG_TP_1!
! IVARY = 1 !
! PM25 = 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0,
1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0 !
!END!
14 ! SRCNAM = FUG_TP_2!
! IVARY = 1 !
! PM10 = 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0,
1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0 !
!END!
14 ! SRCNAM = FUG_TP_2!
! IVARY = 1 !
! PM25 = 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0,
1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0 !
!END!
15 ! SRCNAM = FUG_TP_3!
! IVARY = 1 !
! PM10 = 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0,
1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0 !
!END!
15 ! SRCNAM = FUG_TP_3!
! IVARY = 1 !

```

```
! PM25 = 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0,  
        1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0 !  
!END!
```

-----  
a

Data for each species are treated as a separate input subgroup  
and therefore must end with an input group terminator.

-----  
INPUT GROUPS: 15a, 15b, 15c -- Line source parameters  
-----

-----  
Subgroup (15a)  
-----

Number of buoyant line sources  
with variable location and emission  
parameters (NLN2)                  No default ! NLN2 = 0 !

(If NLN2 > 0, ALL parameter data for  
these sources are read from the file: LNEMARB.DAT)

Number of buoyant line sources (NLINES)    No default ! NLINES = 0 !

Units used for line source  
emissions below                  (ILNU)                  Default: 1 ! ILNU = 1 !  
1 =       g/s  
2 =       kg/hr  
3 =       lb/hr  
4 =       tons/yr  
5 =       Odour Unit \* m\*\*3/s (vol. flux of odour compound)  
6 =       Odour Unit \* m\*\*3/min

Number of source-species  
combinations with variable  
emissions scaling factors  
provided below in (15c)        (NSLN1) Default: 0 ! NSLN1 = 0 !

Maximum number of segments used to model  
each line (MXNSEG)                  Default: 7 ! MXNSEG = 7 !

The following variables are required only if NLINES > 0. They are  
used in the buoyant line source plume rise calculations.

Number of distances at which                  Default: 6 ! NLRISE = 6 !  
transitional rise is computed

Average line source length (XL)                  No default ! XL = 0. !  
(in meters)

Average height of line source height (HBL) No default ! HBL = 0. !  
(in meters)

Average building width (WBL)  
(in meters) No default ! WBL = 0. !

Average line source width (WML)      No default ! WML = 0. !  
(in meters)

Average separation between buildings (DXL) No default ! DXL = 0. !  
(in meters)

Average buoyancy parameter (FPRIMEL)  
(in m\*\*4/s\*\*3) No default ! FPRIMEL = 0. !

**!END!**

### Subgroup (15b)

## BUOYANT LINE SOURCE: CONSTANT DATA

Source No.	Beg. X (km)	Beg. Y (km)	End. X (km)	End. Y (km)	Release Height (m)	Base Elevation (m)	a	Emission Rates
------------	----------------	----------------	----------------	----------------	-----------------------	-----------------------	---	----------------

a

Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

b

An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by ILNTU (e.g. 1 for g/s).

### Subgroup (15c)

a  
BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 15b. Factors entered multiply the rates in 15b.  
Skip sources here that have constant emissions.

IVARY determines the type of variation, and is source-specific:

(IVARY) Default: 0

- 0 = Constant  
 1 = Diurnal cycle (24 scaling factors: hours 1-24)  
 2 = Monthly cycle (12 scaling factors: months 1-12)  
 3 = Hour & Season (4 groups of 24 hourly scaling factors,  
       where first group is DEC-JAN-FEB)  
 4 = Speed & Stab. (6 groups of 6 scaling factors, where  
       first group is Stability Class A,

and the speed classes have upper bounds (m/s) defined in Group 12  
5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of:  
0, 5, 10, 15, 20, 25, 30, 35, 40,  
45, 50, 50+)

-----  
a

Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

-----  
INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters  
-----

-----  
Subgroup (16a)  
-----

Number of volume sources with parameters provided in 16b,c (NVL1) No default ! NVL1 = 0 !

Units used for volume source emissions below in 16b (IVLU) Default: 1 ! IVLU = 4 !

1 = g/s  
2 = kg/hr  
3 = lb/hr  
4 = tons/yr  
5 = Odour Unit \* m\*\*3/s (vol. flux of odour compound)  
6 = Odour Unit \* m\*\*3/min

Number of source-species combinations with variable emissions scaling factors provided below in (16c) (NSVL1) Default: 0 ! NSVL1 = 0 !

Gridded volume source data used ? (IGRDVL) No default ! IGRDVL = 0 !

0 = no  
1 = yes (gridded volume source emissions read from the file:  
VOLEM.DAT)

The following parameters apply to the data in the gridded volume source emissions file (VOLEM.DAT)

- Effective height of emissions (VEFFHT) in meters No default ! VEFFHT = 0. !
- Initial sigma y (VSIGYI) in meters No default ! VSIGYI = 0. !

- Initial sigma z (VSIGZI) in  
meters                                  No default ! VSIGZI = 0. !

!END!

-----  
Subgroup (16b)  
-----

a  
VOLUME SOURCE: CONSTANT DATA  
-----  
X UTM    Y UTM    Effect. Base    Initial    Initial    Emission  
Coordinate   Coordinate   Height   Elevation   Sigma y   Sigma z   Rates  
(km)        (km)        (m)        (m)        (m)        (m)  
----- ----- ----- ----- ----- -----

-----  
a  
Data for each source are treated as a separate input subgroup  
and therefore must end with an input group terminator.

b  
An emission rate must be entered for every pollutant modeled.  
Enter emission rate of zero for secondary pollutants that are  
modeled, but not emitted. Units are specified by IVLU  
(e.g. 1 for g/s).

-----  
Subgroup (16c)  
-----

a  
VOLUME SOURCE: VARIABLE EMISSIONS DATA  
-----

Use this subgroup to describe temporal variations in the emission  
rates given in 16b. Factors entered multiply the rates in 16b.  
Skip sources here that have constant emissions. For more elaborate  
variation in source parameters, use VOLEM.DAT and IGRDVL = 1.

IVARY determines the type of variation, and is source-specific:

(IVARY)                                  Default: 0

- 0 = Constant
- 1 = Diurnal cycle (24 scaling factors: hours 1-24)
- 2 = Monthly cycle (12 scaling factors: months 1-12)
- 3 = Hour & Season (4 groups of 24 hourly scaling factors,  
    where first group is DEC-JAN-FEB)
- 4 = Speed & Stab. (6 groups of 6 scaling factors, where  
    first group is Stability Class A,  
    and the speed classes have upper  
    bounds (m/s) defined in Group 12)
- 5 = Temperature (12 scaling factors, where temperature  
    classes have upper bounds (C) of:  
    0, 5, 10, 15, 20, 25, 30, 35, 40,  
    45, 50, 50+)

-----  
a

Data for each species are treated as a separate input subgroup  
and therefore must end with an input group terminator.

-----  
INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information  
-----

-----  
Subgroup (17a)  
-----

Number of non-gridded receptors (NREC) No default ! NREC = 413 !

!END!

-----  
Subgroup (17b)  
-----

a  
NON-GRIDDED (DISCRETE) RECEPTOR DATA

Receptor No.	X UTM (km)	Y UTM (km)	Ground Elevation (m)	
1 ! X =	-36.726,	8.219,	3424.620!	!END!
2 ! X =	-35.777,	17.145,	2984.990!	!END!
3 ! X =	-40.470,	24.809,	3065.655!	!END!
4 ! X =	-44.871,	32.718,	3182.355!	!END!
5 ! X =	-43.938,	41.086,	2713.470!	!END!
6 ! X =	-48.519,	46.488,	2793.870!	!END!
7 ! X =	-50.125,	54.846,	2795.545!	!END!
8 ! X =	-55.793,	59.191,	2893.385!	!END!
9 ! X =	-58.722,	66.272,	2656.290!	!END!
10 ! X =	-65.611,	72.899,	2931.020!	!END!
11 ! X =	-70.032,	80.597,	2855.400!	!END!
12 ! X =	-72.046,	89.401,	2459.390!	!END!
13 ! X =	-75.113,	96.384,	2296.060!	!END!
14 ! X =	-79.683,	96.996,	2466.665!	!END!
15 ! X =	-84.888,	101.131,	2546.575!	!END!
16 ! X =	-92.864,	99.293,	3030.035!	!END!
17 ! X =	-94.803,	92.849,	3307.340!	!END!
18 ! X =	-100.206,	88.978,	2956.305!	!END!
19 ! X =	-100.796,	79.966,	2726.955!	!END!
20 ! X =	-108.774,	79.461,	2824.965!	!END!
21 ! X =	-108.432,	70.474,	2826.645!	!END!
22 ! X =	-108.936,	62.044,	2573.445!	!END!
23 ! X =	-106.313,	61.255,	2739.025!	!END!
24 ! X =	-104.363,	55.254,	2616.145!	!END!
25 ! X =	-97.843,	51.946,	2554.855!	!END!
26 ! X =	-89.794,	49.277,	2926.190!	!END!
27 ! X =	-87.155,	41.700,	2717.725!	!END!
28 ! X =	-83.281,	33.708,	2491.500!	!END!

29 ! X =	-75.690,	32.085,	2888.155!	!END!
30 ! X =	-70.637,	24.977,	2893.935!	!END!
31 ! X =	-64.159,	19.940,	2900.565!	!END!
32 ! X =	-56.547,	17.229,	2909.340!	!END!
33 ! X =	-52.187,	10.080,	2905.600!	!END!
34 ! X =	-44.260,	5.304,	2873.605!	!END!
35 ! X =	-36.696,	7.901,	3393.810!	!END!
1 ! X =	-48.000,	8.000,	2907.000!	!END!
2 ! X =	-44.000,	8.000,	3125.000!	!END!
3 ! X =	-40.000,	8.000,	3112.000!	!END!
4 ! X =	-52.000,	12.000,	3014.000!	!END!
5 ! X =	-48.000,	12.000,	3248.000!	!END!
6 ! X =	-44.000,	12.000,	3278.000!	!END!
7 ! X =	-40.000,	12.000,	3231.000!	!END!
8 ! X =	-52.000,	16.000,	3139.000!	!END!
9 ! X =	-48.000,	16.000,	3445.000!	!END!
10 ! X =	-44.000,	16.000,	3465.000!	!END!
11 ! X =	-40.000,	16.000,	3112.000!	!END!
12 ! X =	-36.000,	16.000,	3004.000!	!END!
13 ! X =	-60.000,	20.000,	2901.000!	!END!
14 ! X =	-56.000,	20.000,	3099.000!	!END!
15 ! X =	-52.000,	20.000,	3104.000!	!END!
16 ! X =	-48.000,	20.000,	3383.000!	!END!
17 ! X =	-44.000,	20.000,	3322.000!	!END!
18 ! X =	-40.000,	20.000,	3132.000!	!END!
19 ! X =	-68.000,	24.000,	2969.000!	!END!
20 ! X =	-64.000,	24.000,	3073.000!	!END!
21 ! X =	-60.000,	24.000,	3010.000!	!END!
22 ! X =	-56.000,	24.000,	3228.000!	!END!
23 ! X =	-52.000,	24.000,	3356.000!	!END!
24 ! X =	-48.000,	24.000,	3270.000!	!END!
25 ! X =	-44.000,	24.000,	3018.000!	!END!
26 ! X =	-72.000,	28.000,	2914.000!	!END!
27 ! X =	-68.000,	28.000,	3028.000!	!END!
28 ! X =	-64.000,	28.000,	3123.000!	!END!
29 ! X =	-60.000,	28.000,	3157.000!	!END!
30 ! X =	-56.000,	28.000,	3333.000!	!END!
31 ! X =	-52.000,	28.000,	3402.000!	!END!
32 ! X =	-48.000,	28.000,	3444.000!	!END!
33 ! X =	-44.000,	28.000,	3140.000!	!END!
34 ! X =	-72.000,	32.000,	2979.000!	!END!
35 ! X =	-68.000,	32.000,	3055.000!	!END!
36 ! X =	-64.000,	32.000,	3229.000!	!END!
37 ! X =	-60.000,	32.000,	3351.000!	!END!
38 ! X =	-56.000,	32.000,	3342.000!	!END!
39 ! X =	-52.000,	32.000,	3198.000!	!END!
40 ! X =	-48.000,	32.000,	3435.000!	!END!
41 ! X =	-80.000,	36.000,	2754.000!	!END!
42 ! X =	-76.000,	36.000,	2804.000!	!END!
43 ! X =	-72.000,	36.000,	2977.000!	!END!
44 ! X =	-68.000,	36.000,	3097.000!	!END!
45 ! X =	-64.000,	36.000,	3333.000!	!END!
46 ! X =	-60.000,	36.000,	3456.000!	!END!
47 ! X =	-56.000,	36.000,	3310.000!	!END!
48 ! X =	-52.000,	36.000,	3054.000!	!END!
49 ! X =	-48.000,	36.000,	3073.000!	!END!
50 ! X =	-44.000,	36.000,	3084.000!	!END!
51 ! X =	-84.000,	40.000,	2801.000!	!END!

52 ! X = -80.000, 40.000, 2968.000! !END!  
 53 ! X = -76.000, 40.000, 3012.000! !END!  
 54 ! X = -72.000, 40.000, 3145.000! !END!  
 55 ! X = -68.000, 40.000, 3201.000! !END!  
 56 ! X = -64.000, 40.000, 3300.000! !END!  
 57 ! X = -60.000, 40.000, 3354.000! !END!  
 58 ! X = -56.000, 40.000, 3392.000! !END!  
 59 ! X = -52.000, 40.000, 3317.000! !END!  
 60 ! X = -48.000, 40.000, 2809.000! !END!  
 61 ! X = -44.000, 40.000, 2798.000! !END!  
 62 ! X = -88.000, 44.000, 2722.000! !END!  
 63 ! X = -84.000, 44.000, 2960.000! !END!  
 64 ! X = -80.000, 44.000, 3082.000! !END!  
 65 ! X = -76.000, 44.000, 3195.000! !END!  
 66 ! X = -72.000, 44.000, 3333.000! !END!  
 67 ! X = -68.000, 44.000, 3392.000! !END!  
 68 ! X = -64.000, 44.000, 3376.000! !END!  
 69 ! X = -60.000, 44.000, 3127.000! !END!  
 70 ! X = -56.000, 44.000, 3194.000! !END!  
 71 ! X = -52.000, 44.000, 3231.000! !END!  
 72 ! X = -88.000, 48.000, 2983.000! !END!  
 73 ! X = -84.000, 48.000, 3091.000! !END!  
 74 ! X = -80.000, 48.000, 3278.000! !END!  
 75 ! X = -76.000, 48.000, 3334.000! !END!  
 76 ! X = -72.000, 48.000, 3349.000! !END!  
 77 ! X = -68.000, 48.000, 3266.000! !END!  
 78 ! X = -64.000, 48.000, 3469.000! !END!  
 79 ! X = -60.000, 48.000, 3281.000! !END!  
 80 ! X = -56.000, 48.000, 2969.000! !END!  
 81 ! X = -52.000, 48.000, 2803.000! !END!  
 82 ! X = -100.000, 52.000, 2571.000! !END!  
 83 ! X = -96.000, 52.000, 2523.000! !END!  
 84 ! X = -92.000, 52.000, 2824.000! !END!  
 85 ! X = -88.000, 52.000, 3133.000! !END!  
 86 ! X = -84.000, 52.000, 3162.000! !END!  
 87 ! X = -80.000, 52.000, 3420.000! !END!  
 88 ! X = -76.000, 52.000, 3317.000! !END!  
 89 ! X = -72.000, 52.000, 3131.000! !END!  
 90 ! X = -68.000, 52.000, 3127.000! !END!  
 91 ! X = -64.000, 52.000, 3407.000! !END!  
 92 ! X = -60.000, 52.000, 3378.000! !END!  
 93 ! X = -56.000, 52.000, 3250.000! !END!  
 94 ! X = -52.000, 52.000, 2845.000! !END!  
 95 ! X = -104.000, 56.000, 2678.000! !END!  
 96 ! X = -100.000, 56.000, 2735.000! !END!  
 97 ! X = -96.000, 56.000, 2898.000! !END!  
 98 ! X = -92.000, 56.000, 3038.000! !END!  
 99 ! X = -88.000, 56.000, 3084.000! !END!  
 100 ! X = -84.000, 56.000, 3365.000! !END!  
 101 ! X = -80.000, 56.000, 3513.000! !END!  
 102 ! X = -76.000, 56.000, 3308.000! !END!  
 103 ! X = -72.000, 56.000, 3037.000! !END!  
 104 ! X = -68.000, 56.000, 2894.000! !END!  
 105 ! X = -64.000, 56.000, 3030.000! !END!  
 106 ! X = -60.000, 56.000, 3132.000! !END!  
 107 ! X = -56.000, 56.000, 3214.000! !END!  
 108 ! X = -52.000, 56.000, 2975.000! !END!  
 109 ! X = -104.000, 60.000, 2883.000! !END!

110 ! X =	-100.000,	60.000,	3019.000!	!END!
111 ! X =	-96.000,	60.000,	3004.000!	!END!
112 ! X =	-92.000,	60.000,	3258.000!	!END!
113 ! X =	-88.000,	60.000,	3275.000!	!END!
114 ! X =	-84.000,	60.000,	3422.000!	!END!
115 ! X =	-80.000,	60.000,	3645.000!	!END!
116 ! X =	-76.000,	60.000,	3464.000!	!END!
117 ! X =	-72.000,	60.000,	3343.000!	!END!
118 ! X =	-68.000,	60.000,	2872.000!	!END!
119 ! X =	-64.000,	60.000,	2713.000!	!END!
120 ! X =	-60.000,	60.000,	2742.000!	!END!
121 ! X =	-108.000,	64.000,	2750.000!	!END!
122 ! X =	-104.000,	64.000,	2904.000!	!END!
123 ! X =	-100.000,	64.000,	3120.000!	!END!
124 ! X =	-96.000,	64.000,	3231.000!	!END!
125 ! X =	-92.000,	64.000,	3305.000!	!END!
126 ! X =	-88.000,	64.000,	3518.000!	!END!
127 ! X =	-84.000,	64.000,	3650.000!	!END!
128 ! X =	-80.000,	64.000,	3409.000!	!END!
129 ! X =	-76.000,	64.000,	3254.000!	!END!
130 ! X =	-72.000,	64.000,	3179.000!	!END!
131 ! X =	-68.000,	64.000,	3326.000!	!END!
132 ! X =	-64.000,	64.000,	3022.000!	!END!
133 ! X =	-60.000,	64.000,	2606.000!	!END!
134 ! X =	-108.000,	68.000,	2859.000!	!END!
135 ! X =	-104.000,	68.000,	3182.000!	!END!
136 ! X =	-100.000,	68.000,	3103.000!	!END!
137 ! X =	-96.000,	68.000,	3286.000!	!END!
138 ! X =	-92.000,	68.000,	3110.000!	!END!
139 ! X =	-88.000,	68.000,	3602.000!	!END!
140 ! X =	-84.000,	68.000,	3647.000!	!END!
141 ! X =	-80.000,	68.000,	3592.000!	!END!
142 ! X =	-76.000,	68.000,	3552.000!	!END!
143 ! X =	-72.000,	68.000,	3513.000!	!END!
144 ! X =	-68.000,	68.000,	3240.000!	!END!
145 ! X =	-64.000,	68.000,	3006.000!	!END!
146 ! X =	-108.000,	72.000,	2922.000!	!END!
147 ! X =	-104.000,	72.000,	3219.000!	!END!
148 ! X =	-100.000,	72.000,	3313.000!	!END!
149 ! X =	-96.000,	72.000,	2935.000!	!END!
150 ! X =	-92.000,	72.000,	3190.000!	!END!
151 ! X =	-88.000,	72.000,	3686.000!	!END!
152 ! X =	-84.000,	72.000,	3404.000!	!END!
153 ! X =	-80.000,	72.000,	3461.000!	!END!
154 ! X =	-76.000,	72.000,	3197.000!	!END!
155 ! X =	-72.000,	72.000,	3289.000!	!END!
156 ! X =	-68.000,	72.000,	3051.000!	!END!
157 ! X =	-108.000,	76.000,	2933.000!	!END!
158 ! X =	-104.000,	76.000,	3224.000!	!END!
159 ! X =	-100.000,	76.000,	2824.000!	!END!
160 ! X =	-96.000,	76.000,	3043.000!	!END!
161 ! X =	-92.000,	76.000,	3451.000!	!END!
162 ! X =	-88.000,	76.000,	3644.000!	!END!
163 ! X =	-84.000,	76.000,	3346.000!	!END!
164 ! X =	-80.000,	76.000,	3181.000!	!END!
165 ! X =	-76.000,	76.000,	3257.000!	!END!
166 ! X =	-72.000,	76.000,	2949.000!	!END!
167 ! X =	-68.000,	76.000,	2869.000!	!END!

168 ! X = -108.000, 80.000, 2871.000! !END!  
 169 ! X = -104.000, 80.000, 3113.000! !END!  
 170 ! X = -100.000, 80.000, 2625.000! !END!  
 171 ! X = -96.000, 80.000, 3160.000! !END!  
 172 ! X = -92.000, 80.000, 3461.000! !END!  
 173 ! X = -88.000, 80.000, 3684.000! !END!  
 174 ! X = -84.000, 80.000, 3412.000! !END!  
 175 ! X = -80.000, 80.000, 3091.000! !END!  
 176 ! X = -76.000, 80.000, 3245.000! !END!  
 177 ! X = -72.000, 80.000, 3133.000! !END!  
 178 ! X = -100.000, 84.000, 2889.000! !END!  
 179 ! X = -96.000, 84.000, 3249.000! !END!  
 180 ! X = -92.000, 84.000, 3432.000! !END!  
 181 ! X = -88.000, 84.000, 3723.000! !END!  
 182 ! X = -84.000, 84.000, 3475.000! !END!  
 183 ! X = -80.000, 84.000, 3188.000! !END!  
 184 ! X = -76.000, 84.000, 2821.000! !END!  
 185 ! X = -72.000, 84.000, 2527.000! !END!  
 186 ! X = -100.000, 88.000, 2942.000! !END!  
 187 ! X = -96.000, 88.000, 3189.000! !END!  
 188 ! X = -92.000, 88.000, 3478.000! !END!  
 189 ! X = -88.000, 88.000, 3489.000! !END!  
 190 ! X = -84.000, 88.000, 3268.000! !END!  
 191 ! X = -80.000, 88.000, 3283.000! !END!  
 192 ! X = -76.000, 88.000, 3048.000! !END!  
 193 ! X = -72.000, 88.000, 2581.000! !END!  
 194 ! X = -96.000, 92.000, 3314.000! !END!  
 195 ! X = -92.000, 92.000, 3326.000! !END!  
 196 ! X = -88.000, 92.000, 3340.000! !END!  
 197 ! X = -84.000, 92.000, 3002.000! !END!  
 198 ! X = -80.000, 92.000, 2850.000! !END!  
 199 ! X = -76.000, 92.000, 2686.000! !END!  
 200 ! X = -92.000, 96.000, 3051.000! !END!  
 201 ! X = -88.000, 96.000, 3059.000! !END!  
 202 ! X = -84.000, 96.000, 3129.000! !END!  
 203 ! X = -80.000, 96.000, 2606.000! !END!  
 204 ! X = -88.000, 100.000, 2748.000! !END!  
 1 ! X = -44.920, -222.722, 2117.590! !END!  
 2 ! X = -49.566, -228.104, 1987.220! !END!  
 3 ! X = -56.453, -230.545, 1573.240! !END!  
 4 ! X = -60.578, -228.888, 1497.450! !END!  
 5 ! X = -64.516, -223.597, 1698.610! !END!  
 6 ! X = -57.119, -221.045, 1765.820! !END!  
 7 ! X = -51.037, -217.107, 1661.150! !END!  
 8 ! X = -43.254, -214.957, 1921.960! !END!  
 9 ! X = -37.264, -210.929, 2167.445! !END!  
 10 ! X = -33.944, -204.173, 2119.855! !END!  
 11 ! X = -30.051, -198.008, 2038.355! !END!  
 12 ! X = -26.130, -196.319, 1784.160! !END!  
 13 ! X = -25.812, -204.983, 2116.375! !END!  
 14 ! X = -29.061, -210.414, 2292.055! !END!  
 15 ! X = -26.168, -217.433, 2159.555! !END!  
 16 ! X = -16.168, -217.452, 2217.290! !END!  
 17 ! X = -9.296, -220.675, 2148.905! !END!  
 18 ! X = -0.009, -221.430, 2142.495! !END!  
 19 ! X = 3.349, -226.902, 1826.955! !END!  
 20 ! X = -5.099, -228.437, 1986.955! !END!  
 21 ! X = -15.099, -228.387, 2173.765! !END!  
 22 ! X = -25.099, -228.338, 2089.460! !END!

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23 ! X = -33.901, -227.120, 2159.360! !END!
24 ! X = -41.035, -224.258, 2162.885! !END!
25 ! X = -42.358, -226.633, 2317.210! !END!
26 ! X = -36.341, -228.918, 2321.575! !END!
27 ! X = -33.196, -236.515, 2282.970! !END!
28 ! X = -34.971, -243.470, 2041.330! !END!
29 ! X = -35.493, -246.712, 1911.225! !END!
30 ! X = -32.167, -239.695, 2337.830! !END!
31 ! X = -36.982, -232.370, 2428.030! !END!
32 ! X = -40.530, -226.571, 2282.810! !END!
1 ! X = -64.000, -228.000, 1488.000! !END!
2 ! X = -60.000, -228.000, 1495.000! !END!
3 ! X = -56.000, -228.000, 1531.000! !END!
4 ! X = -52.000, -228.000, 1797.000! !END!
5 ! X = -32.000, -228.000, 2237.000! !END!
6 ! X = -28.000, -228.000, 2031.000! !END!
7 ! X = -24.000, -228.000, 2111.000! !END!
8 ! X = -20.000, -228.000, 2092.000! !END!
9 ! X = -16.000, -228.000, 2199.000! !END!
10 ! X = -12.000, -228.000, 2114.000! !END!
11 ! X = -8.000, -228.000, 2021.000! !END!
12 ! X = -4.000, -228.000, 1921.000! !END!
13 ! X = 0.000, -228.000, 1822.000! !END!
14 ! X = -64.000, -224.000, 1705.000! !END!
15 ! X = -60.000, -224.000, 1821.000! !END!
16 ! X = -56.000, -224.000, 1860.000! !END!
17 ! X = -52.000, -224.000, 1884.000! !END!
18 ! X = -40.000, -224.000, 2047.000! !END!
19 ! X = -36.000, -224.000, 1863.000! !END!
20 ! X = -32.000, -224.000, 1734.000! !END!
21 ! X = -28.000, -224.000, 1719.000! !END!
22 ! X = -24.000, -224.000, 1778.000! !END!
23 ! X = -20.000, -224.000, 1844.000! !END!
24 ! X = -16.000, -224.000, 1892.000! !END!
25 ! X = -12.000, -224.000, 1942.000! !END!
26 ! X = -8.000, -224.000, 1981.000! !END!
27 ! X = -4.000, -224.000, 2049.000! !END!
28 ! X = 0.000, -224.000, 1986.000! !END!
29 ! X = -52.000, -220.000, 1593.000! !END!
30 ! X = -48.000, -220.000, 1721.000! !END!
31 ! X = -44.000, -220.000, 2100.000! !END!
32 ! X = -40.000, -220.000, 2051.000! !END!
33 ! X = -36.000, -220.000, 1685.000! !END!
34 ! X = -32.000, -220.000, 1760.000! !END!
35 ! X = -28.000, -220.000, 1993.000! !END!
36 ! X = -24.000, -220.000, 2079.000! !END!
37 ! X = -20.000, -220.000, 2060.000! !END!
38 ! X = -16.000, -220.000, 2150.000! !END!
39 ! X = -48.000, -216.000, 1627.000! !END!
40 ! X = -44.000, -216.000, 1777.000! !END!
41 ! X = -40.000, -216.000, 1974.000! !END!
42 ! X = -36.000, -216.000, 1935.000! !END!
43 ! X = -32.000, -216.000, 2024.000! !END!
44 ! X = -40.000, -212.000, 2159.000! !END!
45 ! X = -36.000, -212.000, 2140.000! !END!
46 ! X = -32.000, -212.000, 2168.000! !END!
47 ! X = -32.000, -208.000, 2018.000! !END!

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48 ! X = -28.000, -208.000, 2248.000! !END!  
 49 ! X = -32.000, -204.000, 2127.000! !END!  
 50 ! X = -28.000, -204.000, 2084.000! !END!  
 51 ! X = -28.000, -200.000, 1930.000! !END!  
 52 ! X = -28.000, -196.000, 1699.000! !END!  
 2 ! X = 211.176, -199.773, 3335.145! !END!  
 3 ! X = 214.971, -207.022, 3365.835! !END!  
 5 ! X = 218.398, -206.534, 2951.225! !END!  
 6 ! X = 218.194, -199.142, 3008.445! !END!  
 2 ! X = 216.000, -204.000, 3394.000! !END!  
 4 ! X = 216.000, -200.000, 3189.000! !END!  
 5 ! X = 212.000, -196.000, 3333.000! !END!  
 6 ! X = 216.000, -196.000, 3175.000! !END!  
 7 ! X = 208.000, -192.000, 3127.000! !END!  
 8 ! X = 212.000, -192.000, 3131.000! !END!  
 9 ! X = 214.000, -192.000, 2872.000! !END!  
 10 ! X = 208.000, -188.000, 3005.000! !END!  
 11 ! X = 210.000, -188.000, 2925.000! !END!  
 1 ! X = 171.977, -140.481, 2643.090! !END!  
 2 ! X = 179.686, -139.939, 2963.620! !END!  
 3 ! X = 176.911, -145.578, 2751.130! !END!  
 4 ! X = 169.864, -146.602, 2416.330! !END!  
 5 ! X = 171.449, -140.675, 2618.835! !END!  
 1 ! X = 172.000, -144.000, 2563.000! !END!  
 2 ! X = 176.000, -144.000, 2747.000! !END!  
 3 ! X = 180.000, -144.000, 2888.000! !END!  
 1 ! X = 150.359, -187.838, 2910.990! !END!  
 2 ! X = 147.008, -180.212, 3019.500! !END!  
 3 ! X = 142.876, -176.182, 2961.425! !END!  
 4 ! X = 137.851, -171.545, 2827.655! !END!  
 5 ! X = 144.553, -167.565, 2772.150! !END!  
 6 ! X = 151.469, -171.398, 3117.420! !END!  
 7 ! X = 155.960, -175.146, 2963.220! !END!  
 8 ! X = 160.666, -181.608, 2704.250! !END!  
 9 ! X = 160.223, -189.750, 2812.200! !END!  
 10 ! X = 159.442, -195.485, 2811.690! !END!  
 11 ! X = 159.648, -202.176, 2790.210! !END!  
 12 ! X = 156.291, -206.673, 2980.860! !END!  
 13 ! X = 155.905, -210.552, 2886.580! !END!  
 14 ! X = 149.765, -212.270, 3047.915! !END!  
 15 ! X = 141.972, -208.906, 2680.070! !END!  
 16 ! X = 141.299, -202.888, 2702.285! !END!  
 17 ! X = 144.163, -195.070, 2752.190! !END!  
 18 ! X = 150.122, -190.782, 3007.535! !END!  
 1 ! X = 152.000, -212.000, 3166.000! !END!  
 2 ! X = 140.000, -208.000, 2559.000! !END!  
 3 ! X = 144.000, -208.000, 2830.000! !END!  
 4 ! X = 148.000, -208.000, 3064.000! !END!  
 5 ! X = 152.000, -208.000, 3186.000! !END!  
 6 ! X = 156.000, -208.000, 2915.000! !END!  
 7 ! X = 144.000, -204.000, 2872.000! !END!  
 8 ! X = 148.000, -204.000, 3183.000! !END!  
 9 ! X = 152.000, -204.000, 3402.000! !END!  
 10 ! X = 144.000, -200.000, 2864.000! !END!  
 11 ! X = 148.000, -200.000, 3163.000! !END!  
 12 ! X = 152.000, -200.000, 3418.000! !END!  
 13 ! X = 156.000, -200.000, 3224.000! !END!  
 14 ! X = 148.000, -196.000, 3003.000! !END!

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15 ! X = 152.000, -196.000, 3192.000! !END!
16 ! X = 156.000, -196.000, 3089.000! !END!
17 ! X = 148.000, -192.000, 2777.000! !END!
18 ! X = 152.000, -192.000, 3213.000! !END!
19 ! X = 156.000, -192.000, 3163.000! !END!
20 ! X = 152.000, -188.000, 2987.000! !END!
21 ! X = 156.000, -188.000, 3240.000! !END!
22 ! X = 160.000, -188.000, 2820.000! !END!
23 ! X = 152.000, -184.000, 3299.000! !END!
24 ! X = 156.000, -184.000, 3349.000! !END!
25 ! X = 160.000, -184.000, 2743.000! !END!
26 ! X = 148.000, -180.000, 3068.000! !END!
27 ! X = 152.000, -180.000, 3245.000! !END!
28 ! X = 156.000, -180.000, 3142.000! !END!
29 ! X = 160.000, -180.000, 2735.000! !END!
30 ! X = 148.000, -176.000, 3114.000! !END!
31 ! X = 152.000, -176.000, 3220.000! !END!
32 ! X = 156.000, -176.000, 2966.000! !END!
33 ! X = 140.000, -172.000, 2887.000! !END!
34 ! X = 144.000, -172.000, 2940.000! !END!
35 ! X = 148.000, -172.000, 3035.000! !END!
36 ! X = 152.000, -172.000, 3139.000! !END!
37 ! X = 156.000, -172.000, 2905.000! !END!
38 ! X = 144.000, -168.000, 2736.000! !END!
39 ! X = 148.000, -168.000, 3025.000! !END!
1 ! X = -49.177, 18.395, 3201.0! !END!
2 ! X = -35.218, 7.976, 3432.0! !END!
3 ! X = 157.664, -202.692, 2915.0! !END!
4 ! X = 152.624, -176.105, 3271.0! !END!
5 ! X = 154.501, -201.870, 3402.0! !END!
6 ! X = 185.608, -123.410, 3276.0! !END!
7 ! X = 213.947, -203.283, 2154.0! !END!
8 ! X = 212.428, -198.605, 2207.0! !END!
9 ! X = -49.182, 20.543, 3124.0! !END!
10 ! X = -88.414, 52.779, 3063.0! !END!
11 ! X = -48.390, 14.748, 3491.0! !END!
12 ! X = -86.811, 89.542, 2948.0! !END!

```

-----

a

Data for each receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

## **5.0 PROCESSING OF CALPUFF MODEL RESULTS**

### **5.1 APPEND and CALSUM Utilities**

In order to obtain data useful for comparing to standards and levels of acceptable change (LACs), the CALPUFF concentrations have to be processed with the CALPOST model and associated utilities. Since there were 154 individual CALPUFF runs, eleven emission sets times 14 meteorological periods), and since various standards are for long-term (i.e., annual) as well as short-term averaging periods, the individual CALPUFF runs had to be combined using the APPEND and the CALSUM utility.

The APPEND utility is used to combine the individual meteorological data periods into a single, annual run. This utility was applied individually to the concentration, dry deposition, and wet deposition files to create a set of three data files for each emission scenario (33 annual data files).

The CALSUM utility was then used to arithmetically combine the CALPUFF runs representing the various emission groups in order to obtain pollutant concentration, dry deposition, and wet deposition files for the near-field and a similar set of three data files for the far-field (a total of six combined impact data files). An example of the CALSUM input file used to combine the far-field annual data files to assess overall cumulative impact is presented as Exhibit 5-1 located at the end of this section.

### **5.2 CALPOST Processing**

Once the individual CALPUFF files were combined into annual deposition and concentration files representing the various emission scenarios, the deposition and concentration files had to be processed using the CALPOST routine to yield concentrations for various standard and increment averaging time, wet and dry deposition of various species at the receptors of interest and visibility impacts at the sensitive areas. Again, CALPOST is run using an input control file, an example of which is presented in Exhibit 5-2. Exhibit 5-2 illustrates the input control file used to calculate visibility impacts at the Bridger Wilderness Area sensitive receptors from Desolation Flats Project Sources alone.

#### **5.2.1 Standard and Increment Calculations**

Other than receptor locations, the key input variables in the CALPOST routine for calculating ambient average concentrations of pollutants for which ambient air quality standards and increments are established are the species and averaging time for that species. The species and averaging times selected matched the standards and increments as shown in Table 5-1. The background concentrations are added to the CALPOST results as part of the presentation of results discussed in Section 6 of this report.

Table 5-1 Background Concentrations and Ambient Air Quality Standards (. g/m<sup>3</sup>)

Pollutant and Averaging Time	Background Concentration	Wyoming Ambient Air Quality Standards	Colorado Ambient Air Quality Standards	National Ambient Air Quality Standards	PSD Class I Increment	PSD Class II Increment
CO 1-hr	2,299 <sup>a</sup>	40,000	40,000	40,000	None	None
CO 8-hr	1,148 <sup>a</sup>	10,000	10,000	10,000	None	None
NO <sub>2</sub> Annual	10 <sup>b</sup>	100	100	100	2.5	25
O <sub>3</sub> 1-hr	144 <sup>d</sup>	None	None	235	None	None
O <sub>3</sub> 8-hr	139 <sup>d</sup>	157	157	157	None	None
PM <sub>10</sub> 24-hr	20 <sup>c</sup>	150	150	150	8	30
PM <sub>10</sub> Annual	12 <sup>c</sup>	50	50	50	4	17
PM <sub>2.5</sub> 24-hr	10 <sup>e</sup>	None	None	65	None	None
PM <sub>2.5</sub> Annual	6 <sup>e</sup>	None	None	15	None	None
SO <sub>2</sub> 3-hr	29 <sup>f</sup>	1,300	700	1,300	25	512
SO <sub>2</sub> 24-hr	18 <sup>f</sup>	260	365	365	5	91
SO <sub>2</sub> Annual	5 <sup>f</sup>	60	80	80	2	20

**Note:** Effective February 27, 2001 the U.S. Supreme Court upheld the EPA's position on the proposed national 8-hr ozone and PM2.5 standards. Implementation of these standards is pending.

The ozone 1-hour background concentration represents the 90<sup>th</sup> percentile of the annual maximum daily 1-hour concentrations for the months April through August.

The 8-hour ozone background concentration represents the average annual 4<sup>th</sup> highest daily maximum 8-hour average.

Other short-term background concentrations represent the second highest measured value.

**Sources:**

- a. CDPHE, 1996 - Data collected at Rifle and Mack, Colorado in conjunction with proposed oil shale development during early 1980s.
- b. BLM, 1996 - To supplement monitored NO<sub>2</sub> data, a separate NO<sub>2</sub> modeling analysis was performed which included many NO<sub>x</sub> emission sources.
- c. WDEQ-AQD, 1997 data collected for the Carbon County UCG Project, data collected 9 miles west of Rawlins, WY, June 1994-November, 1994
- d. Clean Air Status and Trends Network, n.d. - Data collected at Pinedale, Wyoming (1997 - 1999).
- e. Background PM<sub>2.5</sub> concentrations estimated at one-half of PM<sub>10</sub> values based upon EPA literature.
- f. CDPHE-APCD, 1996 - Data collected at the Craig Power Plant site and at Colorado Oil Shale areas from 1980 to 1984.

## **5.2.2 Deposition Calculations**

Deposition calculation are equally straight forward, only requiring identification of the species and the deposition time (one year) as inputs. The CALPOST deposition amounts are then used in the Fox acid deposition screening methodology (Fox, 1989) formulation to calculate the change in acid neutralizing capacity (ANC) of the lake.

The Fox acid deposition screening method calculates the change in alkalinity using the following formula:

$$\% \text{ Alkalinity Change} = \{H_s + H_N + H_C\}/d/1000/[A] \times 100$$

Where:

- A = Baseline Alkalinity (eq/l) = ANC/1000000
- d = Annual precipitation (m)
- $H_s = D_s/(10 \times R_s \times 32)$  for  $\text{SO}_2$  (eq/m<sup>2</sup>)
- $H_N = D_N/(10 \times R_N \times 46)$  for  $\text{NO}_2$  (eq/m<sup>2</sup>)
- $H_C = D_C/(10 \times R_C \times 60)$  for COS (= 0 in the Desolation Flats analysis)
- $D_s$  = sulfur deposition (as  $\text{SO}_2$ ). (kg/ha)
- $D_N$  = nitrogen deposition (as  $\text{NO}_2$ ). (kg/ha)
- $D_C$  = sulfur deposition from COS (= 0 in the Desolation Flats analysis)
- $R_s$  = sulfur/total weight of  $\text{SO}_2$  (32/64 = 0.5)
- $R_N$  = nitrogen/total weight of  $\text{NO}_2$  (14/64 = 0.3)
- $R_C$  = sulfur/total weight of COS (32/60 = 0.5)

Dry and wet deposition is calculated by the CALPOST routine and both are included in the deposition calculations.

## **5.2.3 Visibility Calculations**

Calculations of visibility impacts are not as simple as the ambient concentration and deposition calculations, and requires a number of additional parameter selections in the CALPOST input control file.

The visibility impact assessment methodology used for this analysis is called "Method 6" in the CALPOST routine, and computes extinction from speciated particulate measurements and the FLAG seasonal relative humidity adjustment applied to both modeled and measured sulfate and nitrate concentrations. Once the change in extinction is calculated, CALPOST also calculates the change in visibility as measured in deciviews.

The existing background visibility conditions were taken from the mean of the best 20% of days observed by the IMPROVE monitoring network at the Bridger and Mt. Zirkel Wilderness Areas. The Bridger data were used to represent the background visibility conditions at the Bridger, Fitzpatrick, and Popo Agie Wilderness Areas and the Wind River Roadless Area. The Mt. Zirkel data were used to represent conditions in Dinosaur National Monument and the Mt. Zirkel, Savage Run, and Rawah Wilderness Areas. The background data are presented in Tables 5-2 and 5-3.

Table 5-2 Mean of the 20% Cleanest Days at Bridger Wilderness Area 1988-1995

Season	Dry Hygroscopic Extinction (Mm <sup>-1</sup> )	Dry Non-Hygroscopic Extinction (Mm <sup>-1</sup> )	Rayleigh Extinction (Mm <sup>-1</sup> )	f(RH)	Particle Extinction with f(RH) (Mm <sup>-1</sup> )	Reference Level Extinction (Mm <sup>-1</sup> )
Autumn	1.23	4.26	10	2.21	6.98	16.98
Spring	1.92	3.96	10	2.30	8.38	18.38
Summer	1.86	6.32	10	1.56	9.22	19.22
Winter	0.72	3.11	10	2.37	4.82	14.82

Table 5-3 Mean of the 20% Cleanest Days at Mt. Zirkel Wilderness Area 1994-1997

Season	Dry Hygroscopic Extinction (Mm <sup>-1</sup> )	Dry Non-Hygroscopic Extinction (Mm <sup>-1</sup> )	Rayleigh Extinction (Mm <sup>-1</sup> )
Autumn	1.19	3.63	10
Spring	1.77	3.51	10
Summer	1.79	6.08	10
Winter	0.74	2.68	10

Although there are data available Bridger Wilderness through at least 1997, only a subset of the data through 1995 was used in order to avoid double counting monitored and modeled impacts. However, since data were not available prior to 1994 at Mt. Zirkel, the entire data set through 1997 was used.

The following formulae were used in calculating the visibility impacts.

$$b_{\text{source}} = b_{\text{SO}_4} + b_{\text{NO}_3} + b_{\text{fine}} + b_{\text{coarse}}$$

Extinction due to each of the particle scattering components is obtained by applying a scattering/absorption efficiency to the concentration ( $\mu\text{g}/\text{m}^3$  for particulate and ppb for gaseous species) as follows:

$$b_{\text{SO}_4} = 3 [(\text{NH}_4)_2\text{SO}_4]f(\text{RH})$$

$$b_{\text{NO}_3} = 3 [\text{NH}_4\text{NO}_3]f(\text{RH})$$

$$b_{\text{fine}} = 1.0 [\text{PM}_{2.5}]$$

$$b_{\text{coarse}} = 0.6 [\text{PM}_{10} - \text{PM}_{2.5}]$$

The seasonal f(RH) values shown in Table 5-2 were used for Bridger and associated sensitive areas and the FLAG-specified f(RH) value of 2.0 for Mt. Zirkel was used at Mt. Zirkel and associated sensitive areas.

Finally deciview (dv) is calculated from extinction as follows:

$$dv = 10 \ln_e(b_{\text{ext}} / 10 \text{ Mm}^{-1})$$

The change in deciviews caused by an emission source (e.g., the Desolation Flats Project) is found by calculating the deciview value from post-project extinction and subtracting the deciview calculated from pre-project extinction. For example:

$$dV_{\text{Project}} = dV_{\text{Post-project}} - dV_{\text{Pre-project}} = 10 \ln_e [1 + (b_{\text{Post-project}} / b_{\text{Pre-project}})]$$

Although not one of the criterion used in the evaluation of AQRVs, visual range is a commonly used measure of visibility impacts. Visual range is calculated from extinction from the formula:

$$VR(\text{km}) = 3912 / b_{\text{ext}} (\text{Mm}^{-1})$$

Note that the above formulae regarding extinction do not account for the possible impact of light absorption by the NO<sub>2</sub> molecule. This portion of extinction is generally small since the amount of extinction caused by NO<sub>2</sub> absorption is given by:

$$b_{\text{NO}_2} = 0.17 [\text{NO}_2]$$

Note that the coefficient to convert concentration to extinction for NO<sub>2</sub> is 0.17, while the coefficient for sulfate is at least 6 (i.e., 3 times the f(RH)); or less than 3% that of sulfate. This fact and the given circumstance that a person will not be looking through a continuous plume of NO<sub>2</sub> at any given concentration leads to the conclusion that NO<sub>2</sub> absorption is not a significant factor. This conclusion is consistent with what was found in the Pinedale EIS studies.

## Exhibit 5-1 Example CALSUM Control File

```
5          - Number of files
CNANNBR.DAT      - INPUT file name
CNANNDR.DAT      - INPUT file name
CNANNNR.DAT      - INPUT file name
CNANNPR.DAT      - INPUT file name
CNANNRR.DAT      - INPUT file name
CNANNTL.DAT      - OUTPUT file name
F              - Compression flag for OUTPUT file (T, F)
8          - Number of species
1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 - Scaling factors
(aX+b) ea species and ea file
1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 -
Scaling factors (file #2)-
1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -
Scaling factors (file #3)-
1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -1.0 0.0 -
Scaling factors (file #4)-
1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 1.0 0.0 -
Scaling factors (file #5)
CALSUM output file - CALPUFF Simulations 1995 FAR FIELD RECEPTORS
BR + DR - NR - PR + RR (Base + DesFlats - Naughton Redcn. - Redcd Prod. + RFD)
Concentrations of SO2, SO4, NO, NO2, HNO3, NO3, PM10, PM25
```

## Exhibit 5-2 Example CALPOST Control File

CALPOST Concentration Processing -- Desolation Flats Annual 1995  
Project Sources Visibility Method 6  
Bridger Wilderness Receptors Only  
----- Run title (3 lines) -----

### CALPOST MODEL CONTROL FILE

-----

-----

#### INPUT GROUP: 0 -- Input and Output File Names

-----

##### Input Files

-----

File	Default File Name	
Conc/Dep Flux File	MODEL.DAT	! MODDAT =d:\desflats\calpuff\sensrec\dr\cnannr.dat !
Relative Humidity File	VISB.DAT	* VISDAT = * Not needed in Method 6
Background Data File	BACK.DAT	*BACKDAT = *
Transmissometer/ Nephelometer Data File	VSRN.DAT	*VSRDAT = *

##### Output Files

-----

File	Default File Name	
List File	CALPOST.LST	! PSTLST =d:\desflats\calpost\visb\dr\BRDRVVISB.LST !

Pathname for Timeseries Files (blank) \* TSPATH = \*  
(activate with exclamation points only if  
providing NON-BLANK character string)

Pathname for Plot Files (blank) \* PLPATH = \*  
(activate with exclamation points only if  
providing NON-BLANK character string)

User Character String (U) to augment default filenames  
(activate with exclamation points only if  
providing NON-BLANK character string)

Timeseries TSttUUUU.DAT \* TSUNAM = \*

Top Nth Rank Plot RttUUUUU.DAT  
or RttiUUU.GRD \* TUNAM = \*

Exceedance Plot XttUUUUU.DAT  
or XttUUUUU.GRD \* XUNAM = \*

Echo Plot jjjtthhU.DAT  
(Specific Days) or jjjtthhU.GRD \* EUNAM = \*

Visibility Plot V24UUUUU.DAT \* VUNAM = \*

(Daily Peak Summary)

All file names will be converted to lower case if LCFILES = T  
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE

T = lower case ! LCFILES = T !

F = UPPER CASE

NOTE: (1) file/path names can be up to 70 characters in length

NOTE: (2) Filenames for ALL PLOT and TIMESERIES FILES are constructed  
using a template that includes a pathname, user-supplied  
character(s), and fixed strings (tt,ii,jjj, and hh), where

tt = Averaging Period (e.g. 03)

ii = Rank (e.g. 02)

jjj= Julian Day

hh = Hour(ending)

are determined internally based on selections made below.

If a path or user-supplied character(s) are supplied, each  
must contain at least 1 non-blank character.

!END!

INPUT GROUP: 1 -- General run control parameters

Option to run all periods found  
in the met. file(s) (METRUN) Default: 0 ! METRUN = 0 !

METRUN = 0 - Run period explicitly defined below

METRUN = 1 - Run all periods in CALPUFF data file(s)

Starting date: Year (ISYR) -- No default ! ISYR = 1995 !  
(used only if Month (ISMO) -- No default ! ISMO = 1 !  
METRUN = 0) Day (ISDY) -- No default ! ISDY = 1 !  
Hour (ISHR) -- No default ! ISHR = 0 !

Number of hours to process (NHRS) -- No default ! NHRS = 8760 !

Process every hour of data?(NREP) -- Default: 1 ! NREP = 1 !  
(1 = every hour processed,  
2 = every 2nd hour processed,  
5 = every 5th hour processed, etc.)

Species & Concentration/Deposition Information

Species to process (ASPEC) -- No default ! ASPEC = VISIB !  
(ASPEC = VISIB for visibility processing)

Layer/deposition code (ILAYER) -- Default: 1 ! ILAYER = 1 !  
'1' for CALPUFF concentrations,  
'-1' for dry deposition fluxes,  
'-2' for wet deposition fluxes,  
'-3' for wet+dry deposition fluxes.

Scaling factors of the form: -- Defaults: ! A = 0.0 !  
X(new) = X(old) \* A + B A = 0.0 ! B = 0.0 !  
(NOT applied if A = B = 0.0) B = 0.0

Add Hourly Background Concentrations/Fluxes?  
(LBACK) -- Default: F ! LBACK = F !

Receptor information

---

Gridded receptors processed? (LG) -- Default: F ! LG = F !  
Discrete receptors processed? (LD) -- Default: F ! LD = T !  
CTSG Complex terrain receptors processed?  
(LCT) -- Default: F ! LCT = F !

--Report results by DISCRETE receptor RING?  
(only used when LD = T) (LDRING) -- Default: F ! LDRING = F !

--Select range of DISCRETE receptors (only used when LD = T):

Select ALL DISCRETE receptors by setting NDRECP flag to -1;  
OR

Select SPECIFIC DISCRETE receptors by entering a flag (0,1) for each  
0 = discrete receptor not processed

1 = discrete receptor processed

using repeated value notation to select blocks of receptors:

23\*1, 15\*0, 12\*1

Flag for all receptors after the last one assigned is set to 0

(NDRECP) -- Default: -1

! NDRECP = 1,16\*0,23\*1,2\*0,2\*1,3\*0,4\*1,2\*0,  
4\*1,3\*0,5\*1,3\*0,4\*1,3\*0,5\*1,5\*0,  
6\*1,5\*0,6\*1,4\*0,5\*1,5\*0,6\*1,7\*0,  
7\*1,7\*0,6\*1,6\*0,6\*1,7\*0,6\*1,6\*0,  
6\*1,5\*0,5\*1,6\*0,5\*1,5\*0,3\*1,5\*0,  
3\*1 !

--Select range of GRIDDED receptors (only used when LG = T):

X index of LL corner (IBGRID) -- Default: -1 ! IBGRID = 10 !  
(-1 OR 1 <= IBGRID <= NX)

Y index of LL corner (JBGRID) -- Default: -1 ! JBGRID = 10 !  
(-1 OR 1 <= JBGRID <= NY)

X index of UR corner (IEGRID) -- Default: -1 ! IEGRID = 15 !  
(-1 OR 1 <= IEGRID <= NX)

Y index of UR corner (JEGRID) -- Default: -1 ! JEGRID = 15 !  
(-1 OR 1 <= JEGRID <= NY)

Note: Entire grid is processed if IBGRID=JBGRID=IEGRID=JEGRID=-1

--Specific gridded receptors can also be excluded from CALPOST processing by filling a processing grid array with 0s and 1s. If the processing flag for receptor index (i,j) is 1 (ON), that receptor will be processed if it lies within the range delineated by IBGRID, JBGRID,IEGRID,JEGRID and if LG=T. If it is 0 (OFF), it will not be processed in the run. By default, all array values are set to 1 (ON).

Number of gridded receptor rows provided in Subgroup (1a) to identify specific gridded receptors to process

(NGONOFF) -- Default: 0 ! NGONOFF = 0 !

!END!

-----  
Subgroup (1a) -- Specific gridded receptors included/excluded  
-----

Specific gridded receptors are excluded from CALPOST processing by filling a processing grid array with 0s and 1s. A total of NGONOFF lines are read here. Each line corresponds to one 'row' in the sampling grid, starting with the NORTHERNMOST row that contains receptors that you wish to exclude, and finishing with row 1 to the SOUTH (no intervening rows may be skipped). Within a row, each receptor position is assigned either a 0 or 1, starting with the westernmost receptor.

0 = gridded receptor not processed  
1 = gridded receptor processed

Repeated value notation may be used to select blocks of receptors:  
23\*1, 15\*0, 12\*1

Because all values are initially set to 1, any receptors north of the first row entered, or east of the last value provided in a row, remain ON.

(NGXRECP) -- Default: 1

-----  
INPUT GROUP: 2 -- Visibility Parameters (ASPEC = VISIB)  
-----

Maximum relative humidity (%) used in particle growth curve  
(RHMAX) -- Default: 98 ! RHMAX = 90.0 !

Modeled species to be included in computing the light extinction  
Include SULFATE? (LVSO4) -- Default: T ! LVSO4 = T !  
Include NITRATE? (LVNO3) -- Default: T ! LVNO3 = T !  
Include ORGANIC CARBON? (LVOC) -- Default: T ! LVOC = F !  
Include COARSE PARTICLES? (LVMC) -- Default: T ! LVMC = T !  
Include FINE PARTICLES? (LVMF) -- Default: T ! LVMF = T !  
Include ELEMENTAL CARBON? (LVEC) -- Default: T ! LVEC = F !

And, when ranking for TOP-N, TOP-50, and Exceedance tables,  
Include BACKGROUND? (LVBK) -- Default: T ! LVBK = T !

Species name used for particulates in MODEL.DAT file  
COARSE (SPECPMC) -- Default: PMC ! SPECPMC = PM10 !  
FINE (SPECPMF) -- Default: PMF ! SPECPMF = PM25 !

Extinction Efficiency (1/Mm per ug/m\*\*3)

-----  
MODELED particulate species:  
PM COARSE (EEPNC) -- Default: 0.6 ! EEPNC = 0.6 !  
PM FINE (EPMF) -- Default: 1.0 ! EPMF = 1.0 !

BACKGROUND particulate species:

PM COARSE (EEPMBK) -- Default: 0.6 ! EEPMBK = 0.6 !

Other species:

AMMONIUM SULFATE (EESO4) -- Default: 3.0 ! EESO4 = 3.0 !

AMMONIUM NITRATE (EENO3) -- Default: 3.0 ! EENO3 = 3.0 !

ORGANIC CARBON (EEOC) -- Default: 4.0 ! EEOC = 4.0 !

SOIL (EESOIL)-- Default: 1.0 ! EESOIL = 1.0 !

ELEMENTAL CARBON (EEEC) -- Default: 10. ! EEEC = 10.0 !

#### Background Extinction Computation

---

Method used for background light extinction

(MVISBK) -- Default: 6 ! MVISBK = 6 !

- 1 = Supply single light extinction and hygroscopic fraction
  - IWAQM (1993) RH adjustment applied to hygroscopic background and modeled sulfate and nitrate
- 2 = Compute extinction from speciated PM measurements (A)
  - Hourly RH adjustment applied to observed and modeled sulfate and nitrate
  - RH factor is capped at RHMAX
- 3 = Compute extinction from speciated PM measurements (B)
  - Hourly RH adjustment applied to observed and modeled sulfate and nitrate
  - Receptor-hour excluded if RH>RHMAX
  - Receptor-day excluded if fewer than 6 valid receptor-hours
- 4 = Read hourly transmissometer background extinction measurements
  - Hourly RH adjustment applied to modeled sulfate and nitrate
  - Hour excluded if measurement invalid (missing, interference, or large RH)
  - Receptor-hour excluded if RH>RHMAX
  - Receptor-day excluded if fewer than 6 valid receptor-hours
- 5 = Read hourly nephelometer background extinction measurements
  - Rayleigh extinction value (BEXTRAY) added to measurement
  - Hourly RH adjustment applied to modeled sulfate and nitrate
  - Hour excluded if measurement invalid (missing, interference, or large RH)
  - Receptor-hour excluded if RH>RHMAX
  - Receptor-day excluded if fewer than 6 valid receptor-hours
- 6 = Compute extinction from speciated PM measurements
  - FLAG RH adjustment factor applied to observed and modeled sulfate and nitrate

Additional inputs used for MVISBK = 1:

---

Background light extinction (1/Mm)

(BEXTBK) -- No default ! BEXTBK = 0.0 !

Percentage of particles affected by relative humidity

(RHFRAC) -- No default ! RHFRAC = 0.0 !

Additional inputs used for MVISBK = 6:

---

Extinction coefficients for hygroscopic species (modeled and background) are computed using a monthly RH adjustment factor in place of an hourly RH factor (VISB.DAT file is NOT needed). Enter the 12 monthly factors here (RHFAC). Month 1 is January.

(RHFAC) -- No default ! RHFAC = 2.37, 2.37, 2.30, 2.30,  
2.30, 1.56, 1.56, 1.56,  
2.21, 2.21, 2.21, 2.37 !

Additional inputs used for MVISBK = 2,3,6:

-----  
Background extinction coefficients are computed from monthly  
CONCENTRATIONS of ammonium sulfate (BKS04), ammonium nitrate (BKNO3),  
coarse particulates (BKPMC), organic carbon (BKOC), soil (BKSOIL), and  
elemental carbon (BKEC). Month 1 is January.  
(ug/m\*\*3)

(BKS04) -- No default ! BKS04 = 0.24, 0.24, 0.64, 0.64,  
0.64, 0.62, 0.62, 0.62,  
0.41, 0.41, 0.41, 0.24 !

(BKNO3) -- No default ! BKNO3 = 0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0 !

(BKPMC) -- No default ! BKPMC = 0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0 !

(BKOC) -- No default ! BKOC = 0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0 !

(BKSOIL) -- No default ! BKSOIL= 3.11, 3.11, 3.96, 3.96,  
3.96, 6.32, 6.32, 6.32,  
4.26, 4.26, 4.26, 3.11 !

(BKEC) -- No default ! BKEC = 0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0,  
0.0, 0.0, 0.0, 0.0 !

Additional inputs used for MVISBK = 2,3,5,6:

-----  
Extinction due to Rayleigh scattering is added (1/Mm)  
(BEXTRAY) -- Default: 10.0 ! BEXTRAY = 10.0 !

!END!

-----  
INPUT GROUP: 3 -- Output options

-----  
Output Units

-----  
Units for All Output (IPRTU) -- Default: 1 ! IPRTU = 3 !  
for for  
Concentration Deposition  
1 = g/m\*\*3 g/m\*\*2/s  
2 = mg/m\*\*3 mg/m\*\*2/s  
3 = ug/m\*\*3 ug/m\*\*2/s  
4 = ng/m\*\*3 ng/m\*\*2/s  
5 = Odour Units

Visibility: extinction expressed in 1/Mega-meters (IPRTU is ignored)

-----  
Averaging time(s) reported

1-hr averages (L1HR) -- Default: T ! L1HR = F !  
3-hr averages (L3HR) -- Default: T ! L3HR = F !  
24-hr averages (L24HR) -- Default: T ! L24HR = T !  
Run-length averages (LRUNL) -- Default: T ! LRUNL = F !

User-specified averaging time in hours - results for  
an averaging time of NAVG hours are reported for  
NAV greater than 0:  
(NAV) -- Default: 0 ! NAV = 0 !

#### Types of tabulations reported

---

- 1) Visibility: daily visibility tabulations are always reported  
for the selected receptors when ASPEC = VISIB.  
In addition, any of the other tabulations listed  
below may be chosen to characterize the light  
extinction coefficients.  
[List file or Plot/Analysis File]
  
- 2) Top 50 table for each averaging time selected  
[List file only]  
(LT50) -- Default: T ! LT50 = T !
  
- 3) Top 'N' table for each averaging time selected  
[List file or Plot file]  
(LTOPN) -- Default: F ! LTOPN = T !  
  
-- Number of 'Top-N' values at each receptor  
selected (NTOP must be <= 4)  
(NTOP) -- Default: 4 ! NTOP = 2 !  
  
-- Specific ranks of 'Top-N' values reported  
(NTOP values must be entered)  
(ITOP(4) array) -- Default: ! ITOP = 1,2 !  
1,2,3,4
  
- 4) Threshold exceedance counts for each receptor and each averaging  
time selected  
[List file or Plot file]  
(LEXCD) -- Default: F ! LEXCD = F !  
  
-- Identify the threshold for each averaging time by assigning a  
non-negative value (output units).  
  
-- Default: -1.0  
Threshold for 1-hr averages (THRESH1) ! THRESH1 = -1.0 !  
Threshold for 3-hr averages (THRESH3) ! THRESH3 = -1.0 !  
Threshold for 24-hr averages (THRESH24) ! THRESH24 = -1.0 !  
Threshold for NAVG-hr averages (THRESHN) ! THRESHN = -1.0 !

-- Counts for the shortest averaging period selected can be tallied daily, and receptors that experience more than NCOUNT counts over any NDAY period will be reported. This type of exceedance violation output is triggered only if NDAY > 0.

Accumulation period(Days)  
(NDAY) -- Default: 0 ! NDAY = 0 !  
Number of exceedances allowed  
(NCOUNT) -- Default: 1 ! NCOUNT = 1 !

### 5) Selected day table(s)

Echo Option -- Many records are written each averaging period selected and output is grouped by day  
[List file or Plot file]  
(LECHO) -- Default: F ! LECHO = F !

Timeseries Option -- Averages at all selected receptors for each selected averaging period are written to timeseries files. Each file contains one averaging period, and all receptors are written to a single record each averaging time.  
[TSttUUUU.DAT files]  
(LTIME) -- Default: F ! LTIME = F !

-- Days selected for output  
(IECHO(366)) -- Default: 366\*0  
! IECHO = 366\*0 !  
(366 values must be entered)

### Plot output options

---

Plot files can be created for the Top-N, Exceedance, and Echo tables selected above. Two formats for these files are available, DATA and GRID. In the DATA format, results at all receptors are listed along with the receptor location [x,y,val1,val2,...]. In the GRID format, results at only gridded receptors are written, using a compact representation. The gridded values are written in rows (x varies), starting with the most southern row of the grid. The GRID format is given the .GRD extension, and includes headers compatible with the SURFER(R) plotting software.

A plotting and analysis file can also be created for the daily peak visibility summary output, in DATA format only.

Generate Plot file output in addition to writing tables to List file?  
(LPLT) -- Default: F ! LPLT = F !

Use GRID format rather than DATA format, when available?  
(LGRD) -- Default: F ! LGRD = F !

### Additional Debug Output

---

Output selected information to List file

for debugging?

(LDEBUG) -- Default: F ! LDEBUG = F !

!END!

## 6.0 CALPOST RESULTS

### 6.1 Concentrations Compared to Standards and Increments at Sensitive Receptors

#### 6.1.1 Project Related Near-Field Impacts

Tables 6-1 and 6-2 present the project related maximum criteria pollutant concentrations that were predicted for the near-field (4 km to 50 km) domain. The impacts are well below the applicable standards and increments (Class I increments were used for informational purposes only, even though the near-field is all Class II).

Table 6-1 Predicted Maximum Near-Field Impacts Resulting From the Desolation Flats Project

Pollutant and Averaging Period	Receptor of Maximum Impact (LCP x, y km)	Total Project Impact (. g/m <sup>3</sup> )	Monitored Back-ground Level (. g/m <sup>3</sup> )	Maximum Impact Plus Back-ground (. g/m <sup>3</sup> )	National Ambient Air Quality Standard (. g/m <sup>3</sup> )	Wyoming Ambient Air Quality Standard (. g/m <sup>3</sup> )	Colorado Ambient Air Quality Standard (. g/m <sup>3</sup> )	Percentage of Most Stringent Ambient Air Quality Standard
NO <sub>2</sub> Annual	44.0, -156.0	1.51	10	11.51	100	100	100	12%
SO <sub>2</sub> 3-hour	52.0, -144.0	0.15	29	29.15	1,300	1,300	700	4%
SO <sub>2</sub> 24-hour	52.0, -144.0	0.08	18	18.08	365	260	365	7%
SO <sub>2</sub> Annual	36.0, -144.0	0.02	5	5.02	80	60	80	8%
PM <sub>10</sub> 24-hour	44.0, -144.0	4.88	20	24.88	150	150	150	17%
PM <sub>10</sub> Annual	36.0, -144.0	1.55	12	13.55	50	50	50	27%
PM <sub>2.5</sub> 24-hour	44.0, -144.0	1.65	10	11.65	65	NA	NA	18%
PM <sub>2.5</sub> Annual	36.0, -144.0	0.48	6	6.48	15	NA	NA	43%

Note: PM<sub>2.5</sub> background assumed to be one-half of PM<sub>10</sub> background.

Table 6-2 Desolation Flats Near-Field Increment Consumption

Pollutant	Averaging Time	Total Project Impact (. g/m <sup>3</sup> )	PSD Class II Increment (. g/m <sup>3</sup> )	Percentage of Class II Increment (. g/m <sup>3</sup> )
NO <sub>2</sub>	Annual	1.51	25	6%
SO <sub>2</sub>	3-hr	0.15	512	0.03%
SO <sub>2</sub>	24-hr	0.08	91	0.1%
SO <sub>2</sub>	Annual	0.02	20	0.1%
PM <sub>10</sub>	24-hr	4.88	30	16%
PM <sub>10</sub>	Annual	1.55	17	9%

### 6.1.2 Project Related Far-Field Impacts

Tables 6-3 and 6-4 present the maximum predicted criteria pollutant concentrations resulting from the project related sources for the far-field domain (50 km to over 300 km). The maximum impacts for all eight sensitive areas were reviewed, but for the Desolation Flats Project emissions alone, the maxima for all pollutants occurred at Dinosaur National Monument. The impacts are well below the applicable standards and increments (Class I increments were used for informational purposes only, even though the near-field is all Class II). A detailed summary of results for the far-field impacts resulting from the Desolation Flats Project alone (as well as all other emissions groups) is provided in Appendix A.

### 6.1.3 Cumulative Far-Field Impacts

Tables 6-5 and 6-6 present the maximum combined impacts from all sources. The detailed summary of results for the far-field impacts is provided in Appendix A.

Table 6-3 Predicted Maximum Far-Field Impacts Resulting From the Desolation Flats Project

Pollutant and Averaging Time	Receptor of Maximum Impact (LCP x, y km)	Total Project Impact (. g/m <sup>3</sup> )	Monitored Back-ground Level (. g/m <sup>3</sup> )	Maximum Impact Plus Back-ground (. g/m <sup>3</sup> )	National Ambient Air Quality Standard (. g/m <sup>3</sup> )	Wyoming Ambient Air Quality Standard (. g/m <sup>3</sup> )	Colorado Ambient Air Quality Standard (. g/m <sup>3</sup> )	Percentage of Most Stringent Ambient Air Quality Standard
NO <sub>2</sub> Annual	-0.0009, -221.43	0.011	10	10.011	100	100	100	10%
SO <sub>2</sub> 3-hour	-28.0, -208.0	0.017	29	29.017	1,300	1,300	700	4%
SO <sub>2</sub> 24-hour	-25.912, -204.983	0.003	18	18.003	365	260	365	7%
SO <sub>2</sub> Annual	-0.0009, -221.43	0.0001	5	5.0001	80	60	80	8%
PM <sub>10</sub> 24-hour	-25.812, -204.983	0.033	20	20.033	150	150	150	13%
PM <sub>10</sub> Annual	-0.0009, -221.43	0.00007	12	12.00007	50	50	50	24%
PM <sub>2.5</sub> 24-hour	-28.0, -208.0	0.044	10	10.044	65	NA	NA	15%
PM <sub>2.5</sub> Annual	-0.0009, -221.43	0.0009	6	6.0009	15	NA	NA	40%

Note: PM<sub>2.5</sub> background assumed to be one-half of PM<sub>10</sub> background.

Table 6-4 Desolation Flats Far-Field Increment Consumption

Pollutant	Averaging Time	Maximum Project Impact (. g/m <sup>3</sup> )	PSD Class I Increment (. g/m <sup>3</sup> )	Percentage of Class I Increment (. g/m <sup>3</sup> )
NO <sub>2</sub>	Annual	0.011	2.5	0.4%
SO <sub>2</sub>	3-hr	0.017	25	0.07%
SO <sub>2</sub>	24-hr	0.003	5	0.06%
SO <sub>2</sub>	Annual	0.0001	2	0.005%
PM <sub>10</sub>	24-hr	0.033	8	0.4%
PM <sub>10</sub>	Annual	0.00007	4	0.002%

Table 6-5 Comparison of Cumulative Far-Field Impacts with Ambient Air Quality Standards

Pollutant and Averaging Time	Maximum Impact Location	Receptor of Maximum Impact (LCP x, y km)	Cumulative Impact (. g/m <sup>3</sup> )	Monitored Back-ground Level (. g/m <sup>3</sup> )	Maximum Impact Plus Back-ground (. g/m <sup>3</sup> )	Most Stringent NAAQS WAAQS CAAQS (. g/m <sup>3</sup> )	Percentage of Most Stringent Ambient Air Quality Standard
NO <sub>2</sub> Annual	Bridger Wilderness	-83.281, 33.708	0.763	10	10.763	100	11%
SO <sub>2</sub> 3-hr	Dinosaur Ntl. Park	-28.0, -208.0	2.886	29	31.886	700	5%
SO <sub>2</sub> 24-hr	Dinosaur Ntl. Park	-28.0, -208.0	0.862	18	18.862	260	7%
SO <sub>2</sub> Annual	Dinosaur Ntl. Park	-28.0, -208.0	0.014	5	5.014	60	8%
PM <sub>10</sub> 24-hr	Rawah Wilderness	210.0, -188.0	0.105	20	20.105	150	13%
PM <sub>10</sub> Annual	Dinosaur Ntl. Park	-0.0009, -221.43	0.004	12	12.004	50	24%
PM <sub>2.5</sub> 24-hr	Rawah Wilderness	214.0, -188.0	0.201	10	10.201	65	16%
PM <sub>2.5</sub> Annual	Dinosaur Ntl. Park	-0.0009, -221.43	0.005	6	6.005	15	40%

Note: Background PM<sub>2.5</sub> concentration is assumed to be one-half of PM<sub>10</sub>.

Table 6-6 Comparison of Cumulative Far-Field Impacts with PSD Class I Increments

Pollutant	Averaging Time	Total Project Impact (. g/m <sup>3</sup> )	PSD Class I Increment (. g/m <sup>3</sup> )	Percentage of Class I Increment (. g/m <sup>3</sup> )
NO <sub>2</sub>	Annual	0.763	2.5	31%
SO <sub>2</sub>	3-hr	2.886	25	12%
SO <sub>2</sub>	24-hr	0.862	5	17%
SO <sub>2</sub>	Annual	0.014	2	0.7%
PM <sub>10</sub>	24-hr	0.105	8	1.3%
PM <sub>10</sub>	Annual	0.004	4	0.1%

## 6.2 Acid Deposition Analysis

### 6.2.1 Acid Deposition Impacts of Desolation Flats Project Alone

Table 6-7 presents the results of the deposition analysis and change in acid neutralizing capacity (ANC) at the twelve sensitive lakes from the emissions of the Desolation Flats Project alone. Both wet and dry deposition was included in the analysis. Appendix B provides the detailed calculations leading to Table 6-7.

Table 6-7 Acid Deposition Impacts from Desolation Flats Project Emissions Alone

Sensitive Lake	Sensitive Area	Monitored Background ANC (. eq/l)	Level of Acceptable Change	Change In ANC (. eq/l)	Percentage of LAC
Black Joe Lake	Bridger Wilderness	69.0	10% (6.9 . eq/l)	0.008	0.12%
Deep Lake	Bridger Wilderness	61.0	10% (6.1 . eq/l)	0.008	0.13%
Hobbs Lake	Bridger Wilderness	68.0	10% (6.8 . eq/l)	0.005	0.07%
Upper Frozen Lake	Bridger Wilderness	5.7	1 . eq/l	0.008	0.80%
Ross Lake	Fitzpatrick Wilderness	61.4	10% (6.1 . eq/l)	0.004	0.07%
Lower Saddlebag	Popo Agie Wilderness	55.5	10% (5.6 . eq/l)	0.010	0.17%
Pothole A-8	Mount Zirkel Wilderness	16.0	1 . eq/l	0.037	3.7%
Seven Lakes	Mount Zirkel Wilderness	35.5	10% (3.6 . eq/l)	0.069	1.92%
Upper Slide Lake	Mount Zirkel Wilderness	24.7	1 . eq/l	0.039	3.9%
West Glacier Lake	Medicine Bow	26.1	10% (2.6 . eq/l)	0.044	1.69%
Island Lake	Rawah Wilderness	64.6	10% (6.5 . eq/l)	0.031	0.47%
Rawah #4 Lake	Rawah Wilderness	41.2	10% (4.1 . eq/l)	0.032	0.78%

## 6.2.2 Acid Deposition Impacts of Cumulative Emissions from All Sources

Table 6-8 presents a summary of the cumulative deposition impacts. Details of the deposition and ANC calculations are provided in Appendix C.

Table 6-8 Cumulative Acid Deposition Impacts – All Sources

Sensitive Lake	Sensitive Area	Monitored Background ANC (. eq/l)	Level of Acceptable Change	Change In ANC (. eq/l)	Percentage of LAC
Black Joe Lake	Bridger Wilderness	69.0	10% (6.9 . eq/l)	0.246	3.56%
Deep Lake	Bridger Wilderness	61.0	10% (6.1 . eq/l)	0.256	4.19%
Hobbs Lake	Bridger Wilderness	68.0	10% (6.8 . eq/l)	0.133	1.95%
Upper Frozen Lake	Bridger Wilderness	5.7	1 . eq/l	0.271	27.1%
Ross Lake	Fitzpatrick Wilderness	61.4	10% (6.1 . eq/l)	0.073	1.19%
Lower Saddlebag	Popo Agie Wilderness	55.5	10% (5.6 . eq/l)	0.292	5.27%
Pothole A-8	Mount Zirkel Wilderness	16.0	1 . eq/l	0.194	19.4%
Seven Lakes	Mount Zirkel Wilderness	35.5	10% (3.6 . eq/l)	0.279	7.85%
Upper Slide Lake	Mount Zirkel Wilderness	24.7	1 . eq/l	0.199	19.9%
West Glacier Lake	Medicine Bow Wilderness	26.1	10% (2.6 . eq/l)	0.377	14.4%
Island Lake	Rawah Wilderness	64.6	10% (6.5 . eq/l)	0.218	3.37%
Rawah #4 Lake	Rawah Wilderness	41.2	10% (4.1 . eq/l)	0.236	5.72%

### 6.3 Visibility Impact Analysis

#### 6.3.1 Visibility Impacts of Desolation Flats Project Alone

The analysis methodology previously described in Section 5.2.3 was used to assess the visibility impacts of the Desolation Flats Project alone and in combination with all other sources in the cumulative inventory. The results of the visibility impact analysis at the eight sensitive areas for only the Desolation Flats emissions are presented in Table 6-9, and the details are provided in Appendix A. The potential emissions from the proposed Desolation Flats Project are not predicted to cause a change in visibility conditions greater than the 0.5 delta deciview ( $\Delta_{dv}$ ) threshold.

Table 6-9 Visibility Impacts of Desolation Flats Project Emissions Alone

Sensitive Receptor Area	Maximum Visibility Impact ( $\Delta$ dv)	Visibility Significance Criteria ( $\Delta$ dv)	Number of Days Greater Than 0.5 $\Delta$ dv	Number of Days Greater Than 1.0 $\Delta$ dv
Bridger Wilderness	0.079	0.5 / 1.0	0	0
Fitzpatrick Wilderness	0.046	0.5 / 1.0	0	0
Wind River Roadless Area	0.048	0.5 / 1.0	0	0
Popo Agie Wilderness	0.073	0.5 / 1.0	0	0
Dinosaur National Monument	0.239	0.5 / 1.0	0	0
Savage Run Wilderness	0.115	0.5 / 1.0	0	0
Mount Zirkel Wilderness	0.093	0.5 / 1.0	0	0
Rawah Wilderness	0.079	0.5 / 1.0	0	0

Two thresholds of visibility change are reported here, days with greater than 1.0 deciview change, and days with greater than 0.5 deciview change. The USFS uses the 0.5 deciview as a LAC threshold in order to protect visibility in sensitive area from visibility changes. The 1.0 deciview threshold is used in the Regional Haze Regulations as a small but potentially noticeable change in visibility, and therefore will also be used for comparison. The 0.5  $\Delta$  dv and 1.0  $\Delta$  dv thresholds are neither standards nor regulatory limits. Rather, they are used to alert the affected land managers that potential adverse visibility impacts may exist and the land manager may wish to look at the magnitude, duration, frequency, and source of the impacts in more detail, as well as the weather conditions under which the impacts occurred, in order to make a significance determination.

Furthermore, the changes in deciview are reported regardless of the actual weather conditions on the day and at the receptor with a modeled change greater than the thresholds of interest. The presence of precipitation (rain or snow) or heavy fog during a 24-hour period coinciding with a 24-hour visibility degradation event could make such an event not visible and inconsequential. Thus, the results presented in this section are worst-case results that over-estimate the potential impacts.

### **6.3.2 Cumulative Visibility Impacts**

Table 6-10 presents a summary of the cumulative visibility impact analysis. The analysis indicates that there are a total of 25 area-days with greater than 0.5  $\text{L}_{dv}$  and seven area-days with greater than 1.0  $\text{L}_{dv}$ . Table 6-11 lists each area-day greater than 0.5  $\text{L}_{dv}$ . Note that although there are 25 area-days listed, the impacts exceed the thresholds in several areas on the same calendar day. There are only 14 different calendar days with impacts in any area over 0.5  $\text{L}_{dv}$  and 6 different calendar days with impacts over 1.0  $\text{L}_{dv}$ . The greatest number of area-days greater than 0.5  $\text{L}_{dv}$  occurs at the Bridger Wilderness Area. However, the maximum impact of the Desolation Flats Project alone at the Bridger Wilderness area is only 0.079  $\text{L}_{dv}$ , and that occurs on a different day (April 16, 1995) than the maximum cumulative impact (April 10, 1995). On April 10, 1995, the day of maximum cumulative visibility impact, the Desolation Flats contribution to the cumulative total  $\text{L}_{dv}$  at the Bridger Wilderness Area is zero. On average, for the area-days in which the  $\text{L}_{dv}$  is greater than 1.0, the Desolation Flats project contribution is two percent, and for all area-days where the  $\text{L}_{dv}$  is greater than 0.5, the average Desolation Flats contribution is only five percent.

Table 6-10 Summary of Cumulative Visibility Impacts

Sensitive Area	Days > 0.5 L dv	Days >1.0 L dv	Maximum L dv
Bridger Wilderness Area	9	5	2.315
Fitzpatrick Wilderness Area	3	1	1.696
Savage Run Wilderness	2	1	1.377
Popo Agie Wilderness Area	4	0	0.680
Rawah Wilderness	3	0	0.613
Dinosaur National Monument	2	0	0.572
Wind River Roadless Area	1	0	0.826
Mount Zirkel Wilderness	1	0	0.755
Total Visibility Event Days at All Areas	25	7	

Table 6-11 Days with  $\bar{L}_{dv}$  Greater than 0.5, Cumulative Impacts

Rank	Sensitive Area	Julian Day	Cumulative Visibility Impact ( $\bar{L}_{dv}$ )	Desolation Flats Project Contribution ( $\bar{L}_{dv}$ )	Percent Contribution of Desolation Flats Project
1	Bridger Wilderness	100	2.315	0.000	0%
2	Bridger Wilderness	264	1.913	0.000	0%
3	Bridger Wilderness	107	1.794	0.055	3%
4	Fitzpatrick Wilderness	100	1.696	0.000	0%
5	Bridger Wilderness	110	1.442	0.014	1%
6	Savage Run Wilderness	116	1.377	0.115	8%
7	Bridger Wilderness	86	1.334	0.000	0%
8	Bridger Wilderness	85	0.985	0.000	0%
9	Fitzpatrick Wilderness	146	0.873	0.008	1%
10	Wind River Roadless Area	110	0.826	0.015	2%
11	Mount Zirkel Wilderness	116	0.755	0.093	12%
12	Bridger Wilderness	124	0.752	0.004	1%
13	Fitzpatrick Wilderness	124	0.716	0.000	0%
14	Popo Agie Wilderness	146	0.680	0.018	3%
15	Bridger Wilderness	146	0.660	0.016	2%
16	Rawah Wilderness	116	0.613	0.076	12%
17	Rawah Wilderness	113	0.611	0.000	0%
18	Bridger Wilderness	106	0.606	0.079	13%
19	Popo Agie Wilderness	106	0.582	0.073	13%
20	Savage Run Wilderness	263	0.573	0.031	5%
21	Dinosaur National Monument	355	0.572	0.144	25%
22	Dinosaur National Monument	85	0.539	0.003	1%
23	Rawah Wilderness	263	0.536	0.043	8%
24	Popo Agie Wilderness	110	0.532	0.013	2%
25	Popo Agie Wilderness	61	0.512	0.006	1%

## **7.0 CONCLUSIONS**

The cumulative impact analysis predicts that the maximum criteria pollutant concentrations will not exceed federal or state ambient air quality standards. In addition, cumulative impacts are predicted to be less than the PSD Class I increments. Potential impacts to sensitive lake ANC are less than the applicable limits of acceptable change. The only potential adverse impacts that have been identified are visibility impacts in sensitive areas. Visibility impacts of up to 25 days exceeding the 0.5  $\Delta$  dv threshold are predicted as a result of cumulative emissions. However, the presence or absence of the Desolation Flats Project does not significantly change the overall visibility impact. On only two of the 25 area-days would the absence of Desolation Flats change the visibility impacts to below the thresholds, and these are only for days slightly over 0.5  $\Delta$  dv. None of the  $\Delta$  dv area-days over 1.0 would be changed to below the 1.0 threshold with the absence of the Desolation Flats project. Of the two days that Desolation Flats would contribute to 0.5  $\Delta$  dv impacts, one occurs at Dinosaur National Monument while the second occurs at the Rawah Wilderness Area.

## **8.0 REFERENCES**

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## **APPENDIX A**

## **SUMMARY OF RESULTS**

## Appendix A Summary of Results

Project Area	BP - Baseline Permitted		DP - Des Flats Proj Only		PP - Reduced Production		PV - Reasonable Further		NFTL - Near Field Total	
	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor
<b>NO2</b>	Annual	1.23	4,-100	44,-156	0.77	-12,000,-124,000	7.96	16,-100	8.18	16,-100
<b>SO2</b>	3-hour	1.47	72,-96	0.15	52,-144	0.00	0	0	1.47	72,-96
	24-hour	0.40	76,-92	0.08	52,-144	0.00	0	0	0.40	76,-92
<b>PM10</b>	Annual	0.01	88,-72	0.02	36,-144	0.00	0	0	0.03	36,-144
	24-hour	67.72	-8,-92	4.88	44,-144	0.00	0	0	67.72	-8,-92
<b>PM25</b>	Annual	7.38	-8,-92	1.55	36,-144	0.00	0	0	7.38	-8,-92
	24-hour	30.03	-8,-92	1.65	44,-144	0.00	0	0	30.03	-8,-92
<b>BRIDGEER</b>	Annual	3.22	-8,-92	0.48	36,-144	0.00	0	0	3.22	-8,-92
	BR - Baseline Permitted	DR - Des Flats Proj Only		PR - Reduced Production		RV - Reasonable Further		NR - Reduced Naughton		TL - Total All Sources
<b>NO2</b>	Annual	0.022	-83,-281,33,708	0.0004	-44,260,5,304	0.011	-44,260,5,304	0.754	-83,281,33,708	0.006
<b>SO2</b>	3-hour	0.345	-36,-726,8,219	0.002	-87,155,41,700	0.027	-52,187,10,080	0	-83,281,33,708	0.941
	24-hour	0.325	-36,-726,8,219	0.0004	-83,281,33,708	0.084	-63,281,33,708	0	0	-36,726,7,901
<b>PM10</b>	Annual	0.013	-36,-726,7,901	0.00005	-44,260,5,304	0.003	-52,187,10,080	0	0	36,696,7,901
	24-hour	0.047	-83,-281,33,708	0.006	-83,281,33,708	0.031	-83,281,33,708	0	0	0.034
<b>PM25</b>	Annual	0.002	-44,260,5,304	0.00004	-83,281,33,708	0.001	-52,187,10,080	0	0	0.001
	24-hour	0.0051	-83,-281,33,708	0.006	-83,281,33,708	0.024	-108,936,62,044	0	0	-44,260,5,304
<b>VISIBILITY - Results without NO2 Absorption</b>	Annual	0.003	-44,260,5,304	0.00005	-36,696,7,901	0.001	-52,187,10,080	0	0	0.002
Days delta dv >0.50		2	0	0	0	0	6	0	9	
Days delta dv >1.00		0	0	0	0	0	4	0	5	
Day of Largest delta dv		146	106	61	61	100	55	100	100	
Total dv		6,845	6,164	6,268	8,400	4,089	8,400	4,089	8,400	
dV Background		6,085	6,085	6,085	6,085	3,931	6,085	3,931	6,085	
Largest delta dv		0.76	-36,696,7,901	0.079	0.184	-44,260,5,304	2,315	-88,000,52,000	0.57	-88,000,52,000
% Ext by SO4		44.72	0.33	7.26	0	0	0	0	0	
% Ext by NO3		53.99	98.65	90.43	100	100	100	100	100	
% Ext by PM10		0.47	0.33	0.95	0	0	0	0	0	
% Ext by PM2.5		0.82	0.68	1.36	0	0	0	0	0	
24-hr NO2 on delta dv Day				35					120	
<b>DINOSAUR</b>	BR - Baseline Permitted	DR - Des Flats Proj Only		PR - Reduced Production		RV - Reasonable Further		NR - Reduced Naughton		TL - Total All Sources
<b>NO2</b>	Annual	0.038	-25,812,-204,983	0.011	-0,009,-221,430	0.023	-25,812,-204,983	0.03	-28,000,-208,000	0.006
<b>SO2</b>	3-hour	3,202	-28,000,-208,000	0.017	-28,000,-208,000	0.377	-9,296,-220,675	0	2,886	-28,000,-208,000
	24-hour	0,958	-28,000,-208,000	0.003	-25,812,-204,983	0.102	-25,812,-204,983	0	0	-28,000,-208,000
<b>PM10</b>	Annual	0.002	-28,000,-208,000	0.0001	-0,009,-221,430	0.007	-25,812,-204,983	0	0	0.014
	24-hour	0,062	-32,000,-204,983	0.033	-25,812,-204,983	0.073	-36,982,-232,370	0	0	-33,94,-204,173
<b>PM25</b>	Annual	0.005	-0,009,-221,430	0.00007	-0,009,-221,430	0.002	-28,000,-208,000	0	0	0.004
	24-hour	0,072	-30,051,-198,008	0.044	-28,000,-208,000	0.07	-36,982,-232,370	0	0	-0,009,-221,430
<b>VISIBILITY - Results without NO2 Absorption</b>	Annual	0.006	-0,009,-221,430	0.00009	-0,009,-221,430	0.003	-28,000,-208,000	0	0	0.005
Days delta dv >0.50		1	0	0	0	1	0	0	2	
Days delta dv >1.00		0	0	0	0	0	0	0	0	
Day of Largest delta dv		6	324	22	85	327	85	327	355	
Total dv		4,191	4,958	4,082	6,169	4,969	6,169	4,969	4,258	
dV Background		3,686	4,719	3,686	5,642	4,875	5,642	4,875	3,686	
Largest delta dv		0.505	-30,051,-198,008	0.25	-0,009,-221,430	0.396	-25,812,-204,983	0.527	-29,061,-210,414	0.095
% Ext by SO4		10.73	92.41	95.7	0	0	0	0	0	0.572
% Ext by NO3		74.86	1.49	0.40	0	0	0	0	0	11.06
% Ext by PM10		4.86	5.85	0.97	0	0	0	0	0	81.74
% Ext by PM2.5		9.56	257							1.48
24-hr NO2 on delta dv Day										5.73

## Appendix A

### Summary of Results

		BR - Baseline Permitted		DR - Des Flats Proj Only		PR - Reduced Production		RV - Reasonable Further		NR - Reduced Naughton		TL - Total All Sources	
		(ug/m3)	Receptor	(ug/m3)	Receptor	(ug/m3)	Receptor	(ug/m3)	Receptor	(ug/m3)	Receptor	(ug/m3)	Receptor
<b>FITZPATRICK</b>													
NO2	Annual	0.006	-76,000,52,000	0.0002	-76,000,52,000	0.003	-76,000,52,000	0.006	-76,000,52,000	0.002	-76,000,52,000	0.008	-76,000,52,000
SO2	3-hour	0.533	-75,113,96,384	0.0008	-76,000,52,000	0.072	-96,000,92,000	0	0	0	0	0.532	-75,113,96,384
	24-hour	0.207	-75,113,96,384	0.0002	-76,000,52,000	0.018	-96,000,92,000	0	0	0	0	0.206	-75,113,96,384
Annual	0.005	-72,000,52,000	0.00003	-76,000,52,000	0.0009	-76,000,52,000	0	0	0	0	0	0.004	-72,046,89,401
PM10	24-hour	0.01	-76,000,52,000	0.0028	-72,000,76,000	0.005	-96,000,92,000	0	0	0	0	0.007	-76,000,52,000
Annual	0.0009	-76,000,52,000	0.00002	-72,000,76,000	0.0004	-76,000,52,000	0	0	0	0	0	0.0006	-76,000,52,000
PM25	24-hour	0.015	-76,000,52,000	0.002	-76,000,52,000	0.006	-96,000,92,000	0	0	0	0	0.012	-72,000,56,000
Annual	0.001	-76,000,52,000	0.00003	-76,000,52,000	0.0004	-76,000,52,000	0	0	0	0	0	0.0009	-76,000,52,000
<b>VISIBILITY - Results without NO2 Absorption</b>													
Days delta dv >0.50	0	0	0	0	0	2	0	0	0	2	0	0	0
Days delta dv >1.00	0	0	0	0	1	1	0	0	1	1	0	0	0
<b>Day of Largest delta dv</b>	146	107	131	100	100	39	100	100	100	100	100	100	100
Total dv	6.3	6.13	6.165	7.78	7.78	4.024	7.78	7.78	7.78	7.78	7.78	7.78	7.78
<b>dV Background</b>	6.085	6.085	6.085	6.085	6.085	3.931	6.085	6.085	6.085	6.085	6.085	6.085	6.085
Largest delta dv	0.215	-72,000,52,000	0.046	-84,000,64,000	0.080	-72,000,52,000	1.696	-84,000,64,000	0.093	-76,000,52,000	0.093	1.696	-84,000,64,000
% Ext by SO4	40.84	0.38	14.05	14.05	0	0	0	0	0	0	0	0	0
% Ext by NO3	57.99	99.03	84.29	84.29	0	0	100	100	100	100	100	100	100
% Ext by PM10	0.41	0.1	0.5	0.5	0.5	0	0	0	0	0	0	0	0
% Ext by PM2.5	0.77	0.5	1.16	1.16	0	0	0	0	0	0	0	0	0
24-hr NO2 on delta dv Day			162										123
<b>MOUNT ZIRKEL</b>													
BR - Baseline Permitted													
DR - Des Flats Proj Only													
NO2	Annual	0.019	137,851,-171,545	0.001	137,851,-171,545	0.01	137,851,-171,545	0.01	137,851,-171,545	0.002	137,851,-171,545	0.027	137,851,-171,545
SO2	3-hour	0.394	137,851,-171,545	0.008	137,851,-171,545	0.077	137,851,-171,545	0	0	0	0	0.379	148,000,-168,000
	24-hour	0.128	137,851,-171,545	0.002	137,851,-171,545	0.025	137,851,-171,545	0	0	0	0	0.112	137,851,-171,545
Annual	0.011	137,851,-171,545	0.00009	137,851,-171,548	0.002	137,851,-171,548	0	0	0	0	0	0.009	137,851,-171,545
PM10	24-hour	0.618	141,972,-208,906	0.016	141,972,-208,906	1.148	140,000,-208,000	0	0	0	0	0.1	141,972,-208,906
Annual	0.057	140,000,-208,000	0.00006	137,851,-171,545	0.12	140,000,-208,000	0	0	0	0	0	0.062	140,000,-208,000
PM25	24-hour	0.458	141,972,-208,906	0.023	137,851,-171,545	0.747	141,972,-208,906	0	0	0	0	0	0
Annual	0.033	140,000,-208,000	0.00008	137,851,-171,545	0.06	140,000,-208,000	0	0	0	0	0	0	0
<b>VISIBILITY - Results without NO2 Absorption</b>													
Days delta dv >0.50	4	0	12	1	1	0	0	0	0	1	0	0	0
Days delta dv >1.00	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Day of Largest delta dv</b>	263	116	266	116	116	3	3	3	3	116	116	116	116
Total dv	5.513	5.735	5.720	6.156	6.156	3.765	6.156	6.156	6.156	6.397	6.397	6.397	6.397
<b>dV Background</b>	4.875	5,642	4,875	5,642	5,642	3,586	5,642	5,642	5,642	5,642	5,642	5,642	5,642
Largest delta dv	0.638	156,000,-172,000	0.093	148,000,-168,000	0.845	141,972,-208,906	0.514	148,000,-168,000	0.078	137,851,-171,545	0.755	148,000,-168,000	
% Ext by SO4	13.36	0.37	0.23	0	0	0	0	0	0	0	0	0	0
% Ext by NO3	84.46	98.23	2.16	100	100	0	0	0	0	0	0	0	0
% Ext by PM10	0.52	0.44	45.58	0	0	0	0	0	0	0	0	0.21	0
% Ext by PM2.5	1.67	0.96	52.03	0	0	0	0	0	0	0	0	0.70	0.70
24-hr NO2 on delta dv Day			401										401

## Appendix A Summary of Results

<b>POPO AGE</b>		<b>BR - Baseline Permitted</b>	<b>DR - Des Flats Proj Only</b>	<b>PR - Reduced Production</b>	<b>RV - Reasonable Further</b>	<b>NR - Reduced Naughton</b>	<b>TL - Total All Sources</b>
		Receptor (ug/m <sup>3</sup> )					
<b>NO2</b>	<b>Annual</b>	-44,000,12,000	-40,000,12,000	-44,000,12,000	-44,000,12,000	-44,000,12,000	-44,000,12,000
<b>SO2</b>	<b>3-hour</b>	1,185	0,0008	0,0008	0,156	0	0
	<b>24-hour</b>	0,344	-35,777,17,145	0,0002	-40,000,12,000	0	-35,777,17,145
	<b>Annual</b>	0,013	-35,777,17,145	0,00005	-40,000,12,000	0	-35,777,17,145
<b>PM10</b>	<b>24-hour</b>	0,036	-40,000,12,000	0,004	-44,871,32,718	0,025	-40,470,24,809
	<b>Annual</b>	0,002	-44,000,12,000	0,00004	-44,000,12,000	0,0009	-40,000,12,000
<b>PM25</b>	<b>24-hour</b>	0,033	-35,777,17,145	0,002	-44,000,16,000	0,017	-44,000,12,000
	<b>Annual</b>	0,003	-40,000,12,000	0,00004	-44,000,12,000	0,0008	-44,000,12,000
<b>VISIBILITY - Results without NO2 Absorption</b>							
Days delta dV >0.50	2	0	0	0	0	0	4
Days delta dV >1.00	0	0	0	0	0	0	0
<b>Day of Largest delta dV</b>	<b>146</b>	106	61	110	55	146	
<b>Total dV</b>	<b>6.84</b>	<b>6,158</b>	<b>6,254</b>	<b>6,584</b>	<b>4,062</b>	<b>6,765</b>	
<b>dV Background</b>							
<b>Largest delta dV</b>	<b>6,085</b>	<b>6,085</b>	<b>6,085</b>	<b>6,085</b>	<b>3,931</b>	<b>6,085</b>	
% Ext by SO4	0,755	-36,000,16,000	0,073	-40,000,12,000	0,169	-56,000,32,000	0,130
% Ext by NO3	45,16	98,69	0,34	7,26	0	0	48,88
% Ext by PM10	0,39	0,36	0,89	90,52	100	100	50,12
% Ext by PM2.5	0,76	0,71	1,34	0	0	0	0,32
<b>24-hr NO2 on delta dV Day</b>		42				0	0,68
<b>RAWAH</b>							
Days delta dV >0.50	2	0	0	0	0	0	3
Days delta dV >1.00	0	0	0	0	0	0	0
<b>Day of Largest delta dV</b>	<b>263</b>	<b>140</b>	<b>263</b>	<b>116</b>	<b>263</b>	<b>116</b>	
<b>Total dV</b>	<b>5,597</b>	<b>5,722</b>	<b>5,090</b>	<b>6,056</b>	<b>4,953</b>	<b>6,256</b>	
<b>dV Background</b>							
<b>Largest delta dV</b>	<b>4,875</b>	<b>5,642</b>	<b>4,875</b>	<b>5,642</b>	<b>4,875</b>	<b>5,642</b>	
% Ext by SO4	0,722	218,194,-199,142	0,079	214,000,-192,000	0,215	218,194,-199,142	0,414
% Ext by NO3	86,84	98,15	86,40	100	0	93,26	
% Ext by PM10	0,42	0,46	0,80	0	0	0,14	
% Ext by PM2.5	1,51	0,89	2,26	0	0	0,61	
<b>24-hr NO2 on delta dV Day</b>		335				327	

## Appendix A Summary of Results

SAVAGE RUN		BR - Baseline Permitted		DR - Des Flats Proj Only		PR - Reduced Production		RV - Reasonable Further		NR - Reduced Naughton		TL - Total All Sources	
		Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )
<b>NO2</b>	<b>Annual</b>	169.864,-146.602	0.028	169.864,-146.602	0.0004	169.864,-146.602	0.007	168.208,-140.481	0.009	171.449,-140.675	0.002	171.449,-140.675	0.032
<b>SO2</b>	<b>3-hour</b>	0.408	169.864,-146.602	0.003	169.864,-146.602	0.064	171.449,-140.675	0	0	0	0.406	169.864,-146.602	0.032
	<b>24-hour</b>	0.009	169.864,-146.602	0.0005	169.864,-146.602	0.018	171.449,-140.675	0	0	0	0.083	169.864,-146.602	0.032
<b>PM10</b>	<b>Annual</b>	0.011	171.449,-140.675	0.0004	169.864,-146.602	0.002	171.449,-140.675	0	0	0	0.009	171.449,-140.675	0
	<b>24-hour</b>	0.03	171.449,-140.675	0.005	179.686,-139.939	0.037	169.864,-146.602	0	0	0	0.028	180.000,-144.000	0
<b>PM25</b>	<b>Annual</b>	0.002	169.864,-146.602	0.0002	169.864,-146.602	0.002	169.864,-146.602	0	0	0	0.001	179.686,-139.939	0
	<b>24-hour</b>	0.066	169.864,-146.602	0.012	169.864,-146.602	0.076	169.864,-146.602	0	0	0	0.033	180.000,-144.000	0
<b>PM25</b>	<b>Annual</b>	0.004	169.864,-146.602	0.0003	169.864,-146.602	0.004	169.864,-146.602	0	0	0	0.002	179.686,-139.939	0
<b>VISIBILITY - Results without NO2 Absorption</b>													
Days delta dv >0.50		2	0	0	0	0	1	0	0	0	2	0	0
Days delta dv >1.00		0	0	0	0	0	1	0	0	0	1	0	0
<b>Day of Largest delta dv</b>		263	116	263	5.109	263	116	263	6.674	263	116	263	116
<b>Total dv</b>		5.861	5.757	5.642	4.875	5.642	5.642	5.642	4.875	5.642	5.642	5.642	7.019
<b>dV Background</b>		4.875	5.642	169.864,-146.602	0.234	179.686,-139.939	1.031	169.864,-146.602	0.091	1.377	169.864,-146.602	0	0
<b>Largest delta dv</b>		0.787	179.686,-139.939	0.115	169.864,-146.602	0.234	179.686,-139.939	0	0	100	100	100	93.82
% Ext by SO4		12.88	0.4	97.43	86.8	97.43	86.8	97.43	86.8	0	0	0	5.15
% Ext by NO3		0.35	0.58	0.45	0.45	0.58	0.45	0.58	0.45	0	0	0	0.25
% Ext by PM10		0.35	1.12	1.59	1.13	1.59	1.13	1.59	1.13	0	0	0	0.79
% Ext by PM2.5				340									340
<b>24-hr NO2 on delta dv Day</b>													
<b>WIND RIVER</b>		BR - Baseline Permitted		DR - Des Flats Proj Only		PR - Reduced Production		RV - Reasonable Further		NR - Reduced Naughton		TL - Total All Sources	
		Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )	Receptor	(ug/m <sup>3</sup> )
<b>NO2</b>	<b>Annual</b>	60.000	0.008	60.000	0.0005	60.000	0.003	-60.000	0.011	-60.000	0.003	-60.000	0.012
<b>SO2</b>	<b>3-hour</b>	0.908	-43.938,41.086	0.00005	-60.000,36.000	0.074	-60.000,36.000	0	0	0	0.907	-43.938,41.086	0
	<b>24-hour</b>	0.026	-44.000,36.000	0.0002	-60.000,36.000	0.017	-60.000,36.000	0	0	0	0.258	-44.000,36.000	0
<b>PM10</b>	<b>Annual</b>	0.009	-44.000,36.000	0.00003	-60.000,36.000	0.001	-60.000,36.000	0	0	0	0.008	-44.000,36.000	0
	<b>24-hour</b>	0.022	-43.938,41.086	0.010	-50.125,54.846	0.023	-44.000,36.000	0	0	0	0.018	-43.938,41.086	0
<b>PM25</b>	<b>Annual</b>	0.001	-44.000,36.000	0.00005	-50.125,54.846	0.0005	-60.000,36.000	0	0	0	0.0007	-44.000,36.000	0
	<b>24-hour</b>	0.031	-43.938,41.086	0.003	-50.125,54.846	0.012	-44.000,36.000	0	0	0	0.029	-43.938,41.086	0
<b>PM25</b>	<b>Annual</b>	0.002	-44.000,36.000	0.00003	-44.000,36.000	0.0005	-44.000,36.000	0	0	0	0.001	-44.000,36.000	0
<b>VISIBILITY - Results without NO2 Absorption</b>		Days delta dv >0.50		1		0		0		1		1	
Days delta dv >1.00		0	0	0	0	0	0	0	0	0	0	0	0
<b>Day of Largest delta dv</b>		146	106	61	6.194	110	39	110	6.877	4.030	6.91	6.91	0
<b>Total dv</b>		6.589	6.154	6.132	6.085	6.085	3.391	3.391	6.085	6.085	0.826	-60.000,36.000	0.826
<b>dV Background</b>													2.3
<b>Largest delta dv</b>		0.505	-44.000,36.000	0.048	-44.000,36.000	0.110	0.792	-60.000,36.000	0.098	0.098	0.098	0.098	99.53
% Ext by SO4		45.55	0.35	7.29	90.89	100	100	100	99.53	0.03	0.03	0.03	0
% Ext by NO3		53.45	98.88	0.22	0.65	0.17	0	0	0.03	0.14	0.14	0.14	81
% Ext by PM10		0.31	0.7	0.56									
% Ext by PM2.5													
<b>24-hr NO2 on delta dv Day</b>													

## Appendix A Summary of Results

LAKE\$	Deep Lake	Bridgeper -1	BR -Baseline Permitted	DR - Des Flats Proj Only		PR - Reduced Production		RV - Reasonable Further		NR - Reduced Naughton	TL - Total All Sources
				ug/m**2/sec	ug/m**2/sec	ug/m**2/sec	ug/m**2/sec	ug/m**2/sec	ug/m**2/sec		
<b>Dry Deposition</b>											
	SO2	2.6275E-05	1.1405E-08	5.0122E-06		0.0000E+00		0.0000E+00		2.1274E-05	
	SO4	2.5557E-07	2.1737E-10	4.4138E-08		0.0000E+00		0.0000E+00		2.0965E-07	
	NO	7.4864E-07	2.3015E-08	3.2219E-07		1.6854E-06		2.7102E-07		1.8638E-06	
	NO2	2.5685E-06	6.5815E-07	1.1963E-05		3.9456E-06		9.5372E-06		4.4499E-06	
	NO3	4.3086E-07	1.4557E-08	1.7346E-07		4.6656E-07		1.1027E-07		4.1823E-07	
	HNO3	5.3265E-05	2.0693E-06	2.2936E-05		3.0374E-05		1.8286E-05		4.4477E-05	
<b>Wet Deposition</b>											
	SO2	1.3723E-05	8.9621E-09	1.2922E-06		0.0000E+00		0.0000E+00		1.2439E-05	
	SO4	9.4165E-06	9.7766E-09	1.0766E-09		0.0000E+00		0.0000E+00		8.3491E-06	
	NO3	2.2249E-05	1.8067E-06	7.4361E-06		6.5504E-06		2.9533E-06		2.0212E-05	
	HNO3	1.1118E-05	8.4333E-07	3.4812E-06		2.3698E-06		7.8141E-07		1.0063E-05	
L. Saddlebag	Popo Agie -2										
	SO2	3.5695E-05	1.3077E-08	5.8588E-06		0.0000E+00		0.0000E+00		2.9849E-05	
	SO4	3.3512E-07	2.3625E-10	5.4032E-08		0.0000E+00		0.0000E+00		2.8133E-07	
	NO	9.5920E-07	2.3930E-08	4.5014E-07		1.3939E-06		2.7778E-07		1.9355E-06	
	NO2	3.3439E-05	8.1213E-07	1.9938E-05		3.9563E-05		1.1349E-05		4.2528E-05	
	NO3	5.8142E-07	2.6389E-08	2.3584E-07		2.0557E-07		1.3800E-07		4.3954E-07	
	HNO3	6.6225E-05	2.2656E-06	3.0320E-05		2.3707E-05		1.8288E-05		4.3580E-05	
<b>Wet Deposition</b>											
	SO2	2.2716E-05	1.2373E-08	1.6688E-06		0.0000E+00		0.0000E+00		2.1060E-05	
	SO4	1.4225E-05	1.2719E-08	1.2975E-06		0.0000E+00		0.0000E+00		1.2940E-05	
	NO3	3.0140E-06	2.1444E-06	1.0106E-05		6.5056E-06		4.2933E-06		2.4480E-05	
	HNO3	1.3740E-05	1.3276E-06	4.6597E-06		2.5083E-06		5.0386E-07		1.2412E-05	
Pothole A-8	Mt. Zirkel -3										
	SO2	2.1732E-05	1.1289E-07	4.8820E-06		0.0000E+00		0.0000E+00		1.8963E-05	
	SO4	2.3721E-07	7.4839E-10	5.1951E-08		0.0000E+00		0.0000E+00		1.8600E-07	
	NO	6.0423E-07	2.0178E-07	3.3363E-07		7.8308E-07		9.2832E-08		1.1626E-06	
	NO2	3.1136E-05	9.5338E-06	1.5259E-05		1.9091E-05		4.6630E-06		3.9837E-05	
	NO3	7.5885E-07	1.3071E-07	3.5123E-07		1.7053E-07		1.3139E-07		5.7747E-07	
	HNO3	2.8713E-05	6.4850E-06	1.3668E-05		1.2757E-05		4.2598E-06		3.0029E-05	
<b>Wet Deposition</b>											
	SO2	6.0112E-06	3.4200E-08	1.4544E-06		0.0000E+00		0.0000E+00		4.3910E-06	
	SO4	6.3923E-06	2.5333E-08	1.2688E-06		0.0000E+00		0.0000E+00		5.1489E-06	
	NO3	2.3144E-05	4.9166E-06	1.0561E-05		4.7608E-06		3.0647E-06		1.9196E-05	
	HNO3	6.0116E-06	2.0055E-06	3.1086E-06		1.2066E-06		1.0872E-06		5.0282E-06	
Seven Lakes	Mt. Zirkel -4										
	SO2	3.3426E-05	2.1608E-07	7.0163E-06		0.0000E+00		0.0000E+00		2.6626E-05	
	SO4	3.5805E-07	1.3137E-09	7.3744E-08		0.0000E+00		0.0000E+00		2.8562E-07	
	NO	7.9936E-07	3.1134E-07	4.2397E-07		6.7713E-07		9.9056E-08		1.2649E-06	
	NO2	4.9235E-05	2.0646E-05	2.4840E-05		2.1410E-05		5.6635E-06		6.0981E-05	
	NO3	1.0863E-06	2.4538E-07	5.3902E-07		2.1954E-07		1.7200E-07		8.3925E-07	
	HNO3	3.8365E-05	1.1991E-05	1.8759E-05		1.2299E-05		4.8947E-06		3.9001E-05	
<b>Wet Deposition</b>											
	SO2	7.5507E-06	5.0998E-08	1.4158E-06		0.0000E+00		0.0000E+00		6.1859E-06	
	SO4	6.3923E-06	3.4119E-08	1.2267E-06		0.0000E+00		0.0000E+00		6.3598E-06	
	NO3	2.8298E-05	6.3638E-06	1.0514E-05		5.8294E-06		2.8088E-06		2.7177E-05	
	HNO3	6.6806E-06	2.5249E-06	3.2611E-06		1.4109E-06		1.2974E-06		6.0579E-06	

## **Appendix A**

### **Summary of Results**

## **Appendix A**

### **Summary of Results**

Black Joe	Bridger -9								
	Dry Deposition								
	SO2	2.5474E-05	1.1110E-08	4.7590E-06	0.0000E+00	0.0000E+00	2.0726E-05		
	SO4	2.4860E-07	2.1615E-10	4.3489E-08	0.0000E+00	0.0000E+00	2.0633E-07		
	NO	7.1459E-07	2.2648E-08	3.0621E-07	1.6276E-06	2.6493E-07	1.7937E-06		
	NO2	2.4506E-05	6.2219E-07	1.1588E-05	3.7060E-05	9.1267E-06	4.1916E-05		
	NO3	4.1873E-07	2.4236E-08	1.6344E-07	2.2933E-07	1.0758E-07	3.9586E-07		
	HNO3	5.2006E-05	2.0739E-06	2.2344E-05	2.8857E-05	1.8138E-05	4.2459E-05		
	Wet Deposition								
	SO2	1.3360E-05	8.4965E-09	1.2660E-06	0.0000E+00	0.0000E+00	1.2102E-05		
	SO4	9.3042E-06	9.4590E-09	1.0605E-06	0.0000E+00	0.0000E+00	8.2331E-06		
	NO3	2.2094E-05	1.7700E-06	7.3375E-06	6.4790E-06	2.9679E-06	2.0038E-05		
	HNO3	1.1002E-05	7.8032E-07	3.4820E-06	2.3029E-06	7.7887E-07	9.8248E-06		
Hobbs	Bridger -10								
	Dry Deposition								
	SO2	1.4621E-05	8.3539E-09	3.5062E-06	0.0000E+00	0.0000E+00	1.1124E-05		
	SO4	2.0087E-07	1.6379E-10	3.1860E-08	0.0000E+00	0.0000E+00	1.6918E-07		
	NO	4.7637E-07	1.8324E-08	1.9507E-07	6.9336E-07	2.2485E-07	7.6841E-07		
	NO2	2.0018E-05	4.7641E-07	8.0372E-06	2.2390E-05	7.2476E-06	2.7600E-05		
	NO3	2.9329E-07	1.8897E-08	1.2743E-07	4.0181E-07	7.0067E-08	3.5487E-07		
	HNO3	2.8417E-05	1.3562E-06	1.1322E-05	1.4633E-05	1.0037E-05	2.3058E-05		
	Wet Deposition								
	SO2	5.8807E-06	2.8724E-09	6.1732E-07	0.0000E+00	0.0000E+00	5.2663E-06		
	SO4	5.1451E-06	5.0086E-09	6.2066E-09	0.0000E+00	0.0000E+00	4.5295E-06		
	NO3	1.0256E-05	1.1713E-06	7.3375E-06	2.9122E-06	2.5775E-06	7.6871E-06		
	HNO3	5.5206E-06	2.0424E-07	1.3001E-06	1.4575E-06	2.5240E-06	3.3583E-06		
Upper Frozen	Bridger -11								
	Dry Deposition								
	SO2	2.7833E-05	1.1867E-08	5.4464E-06	0.0000E+00	0.0000E+00	2.2402E-05		
	SO4	2.6310E-07	2.2008E-10	4.5720E-08	0.0000E+00	0.0000E+00	2.1760E-07		
	NO	8.0602E-07	2.3424E-08	3.5174E-07	1.8046E-06	2.7781E-07	2.0045E-06		
	NO2	2.8247E-05	7.0665E-07	1.3573E-05	4.3775E-05	1.0242E-05	4.8913E-05		
	NO3	4.5630E-07	2.5144E-08	1.8268E-07	2.4322E-07	1.1605E-07	4.2553E-07		
	HNO3	5.5578E-05	2.0704E-06	2.4156E-05	3.0328E-05	1.3846E-05	4.5356E-05		
	Wet Deposition								
	SO2	1.4777E-05	9.8416E-09	1.3615E-06	0.0000E+00	0.0000E+00	1.3425E-05		
	SO4	9.8442E-06	1.0419E-08	1.0847E-06	0.0000E+00	0.0000E+00	8.7770E-06		
	NO3	2.2839E-05	1.8791E-06	7.7096E-06	6.6520E-06	2.9657E-06	2.0695E-05		
	HNO3	1.1405E-05	9.6879E-07	3.5739E-06	2.4821E-06	7.4098E-07	1.0541E-05		
Ross Lake	Fitzpatrick -12								
	Dry Deposition								
	SO2	9.3097E-06	4.6300E-09	1.8258E-06	0.0000E+00	0.0000E+00	7.4885E-06		
	SO4	1.3492E-07	1.3260E-10	2.3198E-08	0.0000E+00	0.0000E+00	1.1126E-07		
	NO	2.4757E-07	9.1455E-09	1.0374E-07	2.5119E-07	1.2517E-07	2.7900E-07		
	NO2	8.9612E-06	2.0785E-07	3.7579E-06	6.2131E-06	4.1355E-06	7.4887E-06		
	NO3	2.8866E-07	1.4467E-08	9.5292E-08	7.8096E-08	5.8633E-08	1.5730E-07		
	HNO3	2.1866E-07	1.1030E-06	7.7403E-06	8.2173E-06	5.6708E-06	1.4471E-05		
	Wet Deposition								
	SO2	1.4776E-05	2.4685E-09	4.0900E-07	0.0000E+00	0.0000E+00	5.3146E-06		
	SO4	4.1979E-06	4.7733E-09	4.9153E-07	0.0000E+00	0.0000E+00	3.7112E-06		
	NO3	7.7747E-06	2.0581E-07	2.8703E-06	6.0933E-06	1.2032E-06	6.6629E-06		
	HNO3	1.0331E-06	2.1582E-07	1.0229E-06	9.6924E-07	1.0871E-06	3.1091E-06		

## **APPENDIX B**

### **SUMMARY OF DEPOSITION FLUX AND ANC IMPACTS DESOLATION FLATS PROJECT EMISSIONS ONLY**

## Appendix B

### Summary of Deposition Flux (Dry and Wet) Modeling Results

#### Project Sources Only

DRY DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (ug/m <sup>2</sup> -sec)	SO <sub>4</sub> (ug/m <sup>2</sup> -sec)	NO (ug/m <sup>2</sup> -sec)	NO <sub>2</sub> (ug/m <sup>2</sup> -sec)	HNO <sub>3</sub> (ug/m <sup>2</sup> -sec)
Bridger	Black Joe Lake	1.1110E-08	2.1615E-10	2.2648E-08	6.2797E-07	2.0739E-06
Bridger	Deep Lake	1.1405E-08	2.1737E-10	2.3015E-08	6.5815E-07	2.0693E-06
Bridger	Hobbs Lake	8.3539E-09	1.6378E-10	1.8324E-08	4.7641E-07	1.3562E-06
Bridger	Upper Frozen Lake	1.1867E-08	2.2008E-10	2.3424E-08	7.0665E-07	2.0704E-06
Fitzpatrick	Ross Lake	4.6306E-09	1.3226E-10	9.1455E-09	2.0785E-07	1.1030E-06
Popo Agie	Lower Saddlebag	1.3077E-08	2.3525E-10	2.3904E-08	8.1213E-07	2.2556E-06
Mount Zirkel	Pothole A-8	1.1289E-07	7.4839E-10	2.0178E-07	9.5388E-06	6.4850E-06
Mount Zirkel	Seven Lakes	2.1608E-07	1.3137E-09	3.1134E-07	2.0646E-05	1.1991E-05
Mount Zirkel	Upper Slide Lake	1.2047E-07	7.7516E-10	2.1570E-07	1.0270E-05	6.7971E-06
Medicine Bow	West Glacier	1.1438E-07	1.6773E-09	2.1570E-07	9.3852E-06	9.7923E-06
Rawah	Island Lake	7.8516E-08	9.3932E-10	1.1628E-07	6.9522E-06	5.4554E-06
Rawah	Rawah #4 Lake	8.1547E-08	9.5672E-10	1.1861E-07	7.3065E-06	5.6458E-06
Rawah						1.8771E-07

WET DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (ug/m <sup>2</sup> -sec)	SO <sub>4</sub> (ug/m <sup>2</sup> -sec)	NO (ug/m <sup>2</sup> -sec)	NO <sub>2</sub> (ug/m <sup>2</sup> -sec)	HNO <sub>3</sub> (ug/m <sup>2</sup> -sec)
Bridger	Black Joe Lake	8.4965E-09	9.4590E-09			7.8032E-07
Bridger	Deep Lake	8.9621E-09	9.7769E-09			8.4334E-07
Bridger	Hobbs Lake	2.8724E-09	5.0086E-09			2.0424E-07
Bridger	Upper Frozen Lake	9.8416E-09	1.0413E-08			9.6879E-07
Fitzpatrick	Ross Lake	2.4685E-09	4.7733E-09			2.1587E-07
Popo Agie	Lower Saddlebag	1.2373E-08	1.2719E-08			1.3276E-06
Mount Zirkel	Pothole A-8	3.4200E-08	2.5335E-08			2.0058E-06
Mount Zirkel	Seven Lakes	5.0998E-08	3.4118E-08			2.5249E-06
Mount Zirkel	Upper Slide Lake	3.6062E-08	2.5696E-08			2.0542E-06
Medicine Bow	West Glacier	3.0291E-08	3.3013E-08			2.0791E-06
Rawah	Island Lake	2.5188E-08	2.7091E-08			2.0356E-06
Rawah	Rawah #4 Lake	2.6218E-08	2.8831E-08			2.2022E-06
Rawah						4.9734E-06

## Appendix B

### Summary of Total Deposition Flux Modeling Results

#### Sensitive Lake Receptors – Project Sources Only

TOTAL (DRY AND WET) DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (ug/m <sup>2</sup> -sec)	SO <sub>4</sub> (ug/m <sup>2</sup> -sec)	NO (ug/m <sup>2</sup> -sec)	NO <sub>2</sub> (ug/m <sup>2</sup> -sec)	HNO <sub>3</sub> (ug/m <sup>2</sup> -sec)
Bridger	Black Joe Lake	1.9607E-08	9.6752E-09	2.2648E-08	6.2279E-07	2.8542E-06
Bridger	Deep Lake	2.0367E-08	9.9943E-09	2.3015E-08	6.5815E-07	8.6790E-07
Bridger	Hobbs Lake	1.1226E-08	5.1724E-09	1.8324E-08	4.7641E-07	1.5604E-06
Bridger	Upper Frozen Lake	2.1709E-08	1.0633E-08	2.3424E-08	7.0665E-07	3.0392E-06
Fitzpatrick	Ross Lake	7.0991E-09	4.9059E-09	9.1455E-09	2.0785E-07	1.3189E-06
Popo Agie	Lower Saddlebag	2.5450E-08	1.2954E-08	2.3904E-08	8.1213E-07	3.5832E-06
Mount Zirkel	Pothole A-8	1.4709E-07	2.6083E-08	2.0178E-07	9.5388E-06	8.4908E-06
Mount Zirkel	Seven Lakes	2.6708E-07	3.5432E-08	3.1134E-07	2.0646E-05	1.4516E-05
Mount Zirkel	Upper Slide Lake	1.5653E-07	2.6471E-08	2.1570E-07	1.0270E-05	8.8513E-06
Mount Zirkel	West Glacier	1.4467E-07	3.4690E-08	2.1570E-07	9.3852E-06	1.1871E-05
Medicine Bow	Island Lake	1.0370E-07	2.8030E-08	1.1628E-07	6.9522E-06	7.4910E-06
Rawah	Rawah #4 Lake	1.0777E-07	2.9788E-08	1.1861E-07	7.3065E-06	7.8480E-06
						5.1611E-06

TOTAL (DRY AND WET) DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (kg/ha-yr)	SO <sub>4</sub> (kg/ha-yr)	NO (kg/ha-yr)	NO <sub>2</sub> (kg/ha-yr)	HNO <sub>3</sub> (kg/ha-yr)
Bridger	Black Joe Lake	6.1831E-06	3.0512E-06	7.1423E-06	1.9804E-04	9.0011E-04
Bridger	Deep Lake	6.4230E-06	3.1518E-06	7.2580E-06	2.0755E-04	2.7370E-04
Bridger	Hobbs Lake	3.5403E-06	1.6312E-06	5.7778E-06	1.5024E-04	4.9210E-04
Bridger	Upper Frozen Lake	6.8460E-06	3.3532E-06	7.3870E-06	2.2285E-04	9.5844E-04
Fitzpatrick	Ross Lake	2.2388E-06	1.5471E-06	2.8841E-06	6.5548E-05	4.1592E-04
Popo Agie	Lower Saddlebag	8.0259E-06	4.0853E-06	7.5384E-06	2.5611E-04	1.1300E-03
Mount Zirkel	Pothole A-8	4.6386E-05	8.2257E-06	6.3633E-05	3.0082E-03	2.6777E-03
Mount Zirkel	Seven Lakes	8.4226E-05	1.1174E-05	9.8184E-05	6.5109E-03	4.5777E-03
Mount Zirkel	Upper Slide Lake	4.9364E-05	8.3479E-06	6.8023E-05	3.2387E-03	2.7913E-03
Medicine Bow	West Glacier	4.5623E-05	1.0940E-05	6.8023E-05	2.9597E-03	3.7438E-03
Rawah	Island Lake	3.2704E-05	8.8396E-06	3.6670E-05	2.1924E-03	2.3624E-03
Rawah	Rawah #4 Lake	3.3985E-05	9.3939E-06	3.7405E-05	2.3042E-03	2.4749E-03
						1.6276E-03

(1) 1 hectare (ha) = 10,000 m<sup>2</sup>

## Appendix B

### Summary of Total Deposition Flux Modeling Results

#### Sensitive Lake Receptors -- Project Sources Only

TOTAL (DRY AND WET) DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (kg/ha-yr)	SO <sub>4</sub> (kg/ha-yr)	NO (kg/ha-yr)	NO <sub>2</sub> (kg/ha-yr)	HNO <sub>3</sub> (kg/ha-yr)
Bridger	Black Joe Lake	6.1831E-06	3.0512E-06	7.1423E-06	1.9804E-04	9.0011E-04
Bridger	Deep Lake	6.4230E-06	3.1518E-06	7.2580E-06	2.0755E-04	2.7370E-04
Bridger	Hobbs Lake	3.5403E-06	1.6312E-06	5.7778E-06	1.5024E-04	4.9210E-04
Bridger	Upper Frozen Lake	6.8460E-06	3.3532E-06	7.3870E-06	2.2285E-04	9.5844E-04
Fitzpatrick	Ross Lake	2.2388E-06	1.5471E-06	2.8841E-06	6.5548E-05	4.1592E-04
Popo Agie	Lower Saddlebag	8.0259E-06	4.0853E-06	7.5384E-06	2.5611E-04	1.1300E-03
Mount Zirkel	Pothole A-8	4.6386E-05	8.2257E-06	6.3633E-05	3.0082E-03	2.6777E-03
Mount Zirkel	Seven Lakes	8.4226E-05	1.1174E-05	9.8184E-05	6.5109E-03	4.5777E-03
Mount Zirkel	Upper Slide Lake	4.9364E-05	8.3479E-06	6.8023E-05	3.2387E-03	2.7913E-03
Medicine Bow	West Glacier	4.5623E-05	1.0940E-05	6.8023E-05	2.9597E-03	3.7438E-03
Rawah	Island Lake	3.2704E-05	8.8396E-06	3.6670E-05	2.1924E-03	2.3624E-03
Rawah	Rawah #4 Lake	3.3985E-05	9.3939E-06	3.7405E-05	2.3042E-03	2.4749E-03

N and S PORTION OF POLLUTANTS						
Wilderness Area	Lake	S of SO <sub>2</sub> (kg S/ha-yr)	S of SO <sub>4</sub> (kg S/ha-yr)	N of NO (kg N/ha-yr)	N of NO <sub>2</sub> (kg N/ha-yr)	N of HNO <sub>3</sub> (kg N/ha-yr)
Bridger	Black Joe Lake	3.0916E-06	1.0171E-06	3.3333E-06	6.0272E-05	2.0002E-04
Bridger	Deep Lake	3.2115E-06	1.0506E-06	3.3871E-06	6.3169E-05	6.0822E-05
Bridger	Hobbs Lake	1.7702E-06	5.4372E-07	2.6967E-06	4.5725E-05	1.0936E-04
Bridger	Upper Frozen Lake	3.4230E-06	1.1177E-06	3.4473E-06	6.7824E-05	2.1299E-04
Fitzpatrick	Ross Lake	5.1194E-06	5.1571E-07	1.3459E-06	1.9949E-05	9.2426E-05
Popo Agie	Lower Saddlebag	4.0130E-06	1.3618E-06	3.5179E-06	7.7948E-05	2.5111E-04
Mount Zirkel	Pothole A-8	2.3193E-05	2.7419E-06	2.9696E-05	9.1553E-04	5.9504E-04
Mount Zirkel	Seven Lakes	4.2113E-05	3.7246E-06	4.5819E-05	1.9816E-03	1.0173E-03
Mount Zirkel	Upper Slide Lake	2.4682E-05	2.7826E-06	3.1744E-05	9.8571E-04	6.2030E-04
Medicine Bow	West Glacier	2.2812E-05	3.6466E-06	3.1744E-05	9.0078E-04	8.3195E-04
Rawah	Island Lake	1.6352E-05	2.9465E-06	1.7113E-05	6.6727E-04	5.2497E-04
Rawah	Rawah #4 Lake	1.6992E-05	3.1313E-06	1.7456E-05	7.0127E-04	5.4999E-04

## Appendix B

### Deposition Fluxes (Acid Neutralizing Capacity and pH) at Twelve Sensitive Lake Receptors Project Sources Only

Wilderness Area	Lake	Inputs				Delta pH	Delta ANC (%)	Delta ANC ueq/l
		ANC (A) (ueq/l)	ppt (d) (inches)	SO <sub>2</sub> Deposition (kg/ha-yr)	NO <sub>x</sub> Deposition (kg/ha-yr)			
Bridger	Black Joe Lake	69.0	48	8.2172E-06	1.2860E-03	0.00005	0.011	0.008
Bridger	Deep Lake	61.0	48	8.5242E-06	1.3254E-03	0.00006	0.013	0.008
Bridger	Hobbs Lake	68.0	48	4.6278E-06	7.9689E-04	0.00003	0.007	0.005
Bridger	Upper Frozen Lake	5.7	48	9.0815E-06	1.3795E-03	0.00063	0.145	0.008
Fitzpatrick	Ross Lake	61.4	48	3.2702E-06	6.0770E-04	0.00003	0.006	0.004
Popo Agie	Lower Saddlebag Pothole A-8	55.5	48	1.0749E-05	1.6007E-03	0.00007	0.017	0.010
Mount Zirkel	Seven Lakes	35.5	48	5.1870E-05	6.2418E-03	0.00102	0.234	0.037
Mount Zirkel	Upper Slide Lake	24.7	48	9.1675E-05	1.1552E-02	0.00085	0.195	0.069
Medicine Bow	West Glacier	26.1	48	5.4929E-05	6.5877E-03	0.00069	0.160	0.039
Rawah	Island Lake	64.6	48	5.2917E-05	7.4246E-03	0.00074	0.170	0.044
Rawah	Rawah #4 Lake	41.2	48	3.8597E-05	5.1146E-03	0.00021	0.047	0.031
Rawah				4.0247E-05	5.3762E-03	0.00034	0.078	0.032

Wilderness Area	Lake	Calculated values				
		ANC (A) (eq/l)	ppt (d) (meters)	H <sub>s</sub> (eq/m <sup>2</sup> )	H <sub>n</sub> (eq/m <sup>2</sup> )	H <sub>c</sub> (eq/m <sup>2</sup> )
Bridger	Black Joe Lake	6.90E-05	1.219	5.1358E-08	9.3190E-06	0.0000E+00
Bridger	Deep Lake	6.10E-05	1.219	5.3276E-08	9.6045E-06	0.0000E+00
Bridger	Hobbs Lake	6.80E-05	1.219	2.8924E-08	5.7746E-06	0.0000E+00
Bridger	Upper Frozen Lake	5.70E-06	1.219	5.6760E-08	9.9966E-06	0.0000E+00
Fitzpatrick	Ross Lake	6.14E-05	1.219	2.0439E-08	4.4036E-06	0.0000E+00
Popo Agie	Lower Saddlebag Pothole A-8	5.55E-05	1.219	6.7184E-08	1.1599E-05	0.0000E+00
Mount Zirkel	Seven Lakes	1.60E-05	1.219	3.2419E-07	4.5230E-05	0.0000E+00
Mount Zirkel	Upper Slide Lake	3.55E-05	1.219	5.7297E-07	8.3707E-05	0.0000E+00
Medicine Bow	West Glacier	2.47E-05	1.219	3.4331E-07	4.7737E-05	0.0000E+00
Rawah	Island Lake	2.61E-05	1.219	3.3073E-07	5.3801E-05	0.0000E+00
Rawah	Rawah #4 Lake	6.46E-05	1.219	2.4123E-07	3.7062E-05	0.0000E+00
Rawah		4.12E-05	1.219	2.5155E-07	3.8958E-05	0.0000E+00

## **APPENDIX C**

### **SUMMARY OF DEPOSITION FLUX AND ANC IMPACTS CUMULATIVE SOURCES**

# Appendix C

## Summary of Deposition Flux (Dry and Wet) Modeling Results

### All Sources in Domain

#### DRY DEPOSITION

Wilderness Area	Lake	$\text{SO}_2$ (ug/m <sup>2</sup> -sec)	$\text{SO}_4$ (ug/m <sup>2</sup> -sec)	NO (ug/m <sup>2</sup> -sec)	$\text{NO}_2$ (ug/m <sup>2</sup> -sec)	$\text{HNO}_3$ (ug/m <sup>2</sup> -sec)	$\text{NO}_3$ (ug/m <sup>2</sup> -sec)
Bridger	Black Joe Lake	2.0726E-05	2.0633E-07	1.7937E-06	4.1910E-05	4.2459E-05	3.9586E-07
Bridger	Deep Lake	2.1274E-05	2.0965E-07	1.8638E-06	4.4499E-05	4.4477E-05	4.1823E-07
Bridger	Hobbs Lake	1.1124E-05	1.6918E-07	7.6841E-07	2.7600E-05	2.3058E-05	3.5487E-07
Bridger	Upper Frozen Lake	2.2402E-05	2.1760E-07	2.0045E-06	4.8913E-05	4.5356E-05	4.2593E-07
Fitzpatrick	Ross Lake	7.4885E-06	1.1126E-07	2.7900E-07	7.4887E-06	1.4471E-05	1.5730E-07
Popo Agie	Lower Saddlebag	2.9849E-05	2.8133E-07	1.6352E-06	4.2528E-05	4.3580E-05	4.3954E-07
Mount Zirkel	Pothole A-8	1.6963E-05	1.8600E-07	1.1626E-06	3.9837E-05	3.0028E-05	5.7747E-07
Mount Zirkel	Seven Lakes	2.6626E-05	2.8562E-07	1.2648E-06	6.0981E-05	3.9001E-05	8.3925E-07
Mount Zirkel	Upper Slide Lake	1.7516E-05	1.8831E-07	1.1905E-06	4.1258E-05	3.0495E-05	5.8903E-07
Medicine Bow	West Glacier	2.8334E-05	3.8750E-07	1.5965E-06	7.2161E-05	5.3288E-05	1.8008E-06
Rawah	Island Lake	1.6853E-05	2.4608E-07	1.0449E-06	4.2450E-05	3.3635E-05	9.0496E-07
Rawah	Rawah #4 Lake	1.7762E-05	2.4809E-07	1.1467E-06	4.7383E-05	3.5842E-05	9.4383E-07

#### WET DEPOSITION

Wilderness Area	Lake	$\text{SO}_2$ (ug/m <sup>2</sup> -sec)	$\text{SO}_4$ (ug/m <sup>2</sup> -sec)	NO (ug/m <sup>2</sup> -sec)	$\text{NO}_2$ (ug/m <sup>2</sup> -sec)	$\text{HNO}_3$ (ug/m <sup>2</sup> -sec)	$\text{NO}_3$ (ug/m <sup>2</sup> -sec)
Bridger	Black Joe Lake	1.2102E-05	8.2331E-06			9.8248E-06	2.0038E-05
Bridger	Deep Lake	1.2439E-05	8.3497E-06			1.0068E-05	2.0212E-05
Bridger	Hobbs Lake	5.2663E-06	4.5295E-06			3.3583E-06	7.6871E-06
Bridger	Upper Frozen Lake	1.3425E-05	8.7700E-06			1.0541E-05	2.0695E-05
Fitzpatrick	Ross Lake	5.3146E-06	3.7112E-06			3.1091E-06	6.5682E-06
Popo Agie	Lower Saddlebag	2.1060E-05	1.2940E-05			1.2412E-05	2.4480E-05
Mount Zirkel	Pothole A-8	4.5910E-06	5.1489E-06			5.0282E-06	1.9196E-05
Mount Zirkel	Seven Lakes	6.1859E-06	6.3596E-06			6.0579E-06	2.7177E-05
Mount Zirkel	Upper Slide Lake	4.6470E-06	5.1266E-06			5.0787E-06	1.9357E-05
Medicine Bow	West Glacier	1.0580E-05	1.0695E-05			1.0798E-05	5.1605E-05
Rawah	Island Lake	5.4533E-06	6.5085E-06			7.1534E-06	2.4946E-05
Rawah	Rawah #4 Lake	5.7406E-06	6.8860E-06			7.6280E-06	2.6587E-05

## Appendix C

### Summary of Total Deposition Flux Modeling Results

#### Sensitive Lake Receptors -- All Sources in Domain

TOTAL (DRY AND WET) DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (ug/m <sup>2</sup> -sec)	SO <sub>4</sub> (ug/m <sup>2</sup> -sec)	NO (ug/m <sup>2</sup> -sec)	NO <sub>2</sub> (ug/m <sup>2</sup> -sec)	HNO <sub>3</sub> (ug/m <sup>2</sup> -sec)
Bridger	Black Joe Lake	3.2828E-05	8.4394E-06	1.7937E-06	4.1910E-05	5.2284E-05
Bridger	Deep Lake	3.3713E-05	8.5594E-06	1.8638E-06	4.4499E-05	5.4545E-05
Bridger	Hobbs Lake	1.6390E-05	4.6987E-06	7.6841E-07	2.7600E-05	2.6416E-05
Bridger	Upper Frozen Lake	3.5827E-05	8.9876E-06	2.0045E-06	4.8913E-05	5.5897E-05
Fitzpatrick	Ross Lake	1.2803E-05	3.8225E-06	2.7900E-07	7.4887E-06	1.7580E-05
Popo Agie	Lower Saddlebag	5.0909E-05	1.3221E-05	1.6352E-06	4.2528E-05	5.5992E-05
Mount Zirkel	Pothole A-8	2.1554E-05	5.3349E-06	1.1626E-06	3.9837E-05	3.5056E-05
Mount Zirkel	Seven Lakes	3.2812E-05	6.6452E-06	1.2648E-06	6.0981E-05	4.5059E-05
Mount Zirkel	Upper Slide Lake	2.2163E-05	5.3149E-06	1.1905E-06	4.1258E-05	3.5574E-05
Medicine Bow	West Glacier	3.8914E-05	1.1083E-05	1.5965E-06	7.2161E-05	6.4086E-05
Rawah	Island Lake	2.2306E-05	6.7546E-06	1.0449E-06	4.2450E-05	5.3406E-05
Rawah	Rawah #4 Lake	2.3503E-05	7.1341E-06	1.1467E-06	4.7383E-05	2.5851E-05

TOTAL (DRY AND WET) DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (kg/ha-yr)	SO <sub>4</sub> (kg/ha-yr)	NO (kg/ha-yr)	NO <sub>2</sub> (kg/ha-yr)	HNO <sub>3</sub> (kg/ha-yr)
Bridger	Black Joe Lake	1.0353E-02	2.6615E-03	5.6566E-04	1.3217E-02	1.6488E-02
Bridger	Deep Lake	1.0632E-02	2.6993E-03	5.8777E-04	1.4033E-02	1.7201E-02
Bridger	Hobbs Lake	5.1688E-03	1.4818E-03	2.4233E-04	8.7039E-03	8.3306E-03
Bridger	Upper Frozen Lake	1.1298E-02	2.8343E-03	6.3214E-04	1.5425E-02	1.7628E-02
Fitzpatrick	Ross Lake	4.0376E-03	1.2055E-03	8.7985E-05	2.3616E-03	5.5441E-03
Popo Agie	Lower Saddlebag	1.6055E-02	4.1695E-03	5.1568E-04	1.3412E-02	1.7658E-02
Mount Zirkel	Pothole A-8	6.7973E-03	1.6824E-03	3.6664E-04	1.2563E-02	1.1055E-02
Mount Zirkel	Seven Lakes	1.0348E-02	2.0956E-03	3.9887E-04	1.9231E-02	1.4210E-02
Mount Zirkel	Upper Slide Lake	6.9893E-03	1.6776E-03	3.7544E-04	1.3011E-02	1.1219E-02
Medicine Bow	West Glacier	1.2272E-02	3.4950E-03	5.0347E-04	2.2757E-02	2.0210E-02
Rawah	Island Lake	7.0345E-03	2.1301E-03	3.2952E-04	1.3387E-02	1.2863E-02
Rawah	Rawah #4 Lake	7.4118E-03	2.2498E-03	3.6162E-04	1.4943E-02	1.3709E-02

(1) 1 hectare (ha) = 10,000 m<sup>2</sup>

## Appendix C

### Summary of Total Deposition Flux Modeling Results

#### Sensitive Lake Receptors -- All Sources in Domain

TOTAL (DRY AND WET) DEPOSITION						
Wilderness Area	Lake	SO <sub>2</sub> (kg/ha-yr)	SO <sub>4</sub> (kg/ha-yr)	NO (kg/ha-yr)	NO <sub>2</sub> (kg/ha-yr)	HNO <sub>3</sub> (kg/ha-yr)
Bridger	Black Joe Lake	1.0353E-02	2.6615E-03	5.6556E-04	1.3217E-02	1.6488E-02
Bridger	Deep Lake	1.0632E-02	2.6993E-03	5.8777E-04	1.4033E-02	1.7201E-02
Bridger	Hobbs Lake	5.1688E-03	1.4818E-03	2.4233E-04	8.7039E-03	8.3306E-03
Bridger	Upper Frozen Lake	1.1298E-02	2.8343E-03	6.3214E-04	1.5425E-02	1.7628E-02
Fitzpatrick	Ross Lake	4.0376E-03	1.2055E-03	8.7985E-05	2.3616E-03	5.5441E-03
Popo Agie	Lower Saddlebag	1.6055E-02	4.1695E-03	5.1568E-04	1.3412E-02	1.7658E-02
Mount Zirkel	Pothole A-8	6.7973E-03	1.6824E-03	3.6664E-04	1.2563E-02	1.1055E-02
Mount Zirkel	Seven Lakes	1.0348E-02	2.0956E-03	3.9887E-04	1.9231E-02	1.4210E-02
Mount Zirkel	Upper Slide Lake	6.9893E-03	1.6761E-03	3.7544E-04	1.3011E-02	1.1219E-02
Medicine Bow	West Glacier	1.2272E-02	3.4950E-03	5.0347E-04	2.2757E-02	2.0210E-02
Rawah	Island Lake	7.0345E-03	2.1301E-03	3.2952E-04	1.3387E-02	1.2863E-02
Rawah	Rawah #4 Lake	7.4118E-03	2.2498E-03	3.6162E-04	1.4943E-02	1.3709E-02

N and S PORTION OF POLLUTANTS					
Wilderness Area	Lake	S of SO <sub>2</sub> (kg S/ha-yr)	S of SO <sub>4</sub> (kg S/ha-yr)	N of NO (kg N/ha-yr)	N of NO <sub>2</sub> (kg N/ha-yr)
Bridger	Black Joe Lake	5.1173E-03	8.8715E-04	2.63398E-04	4.0225E-03
Bridger	Deep Lake	5.3159E-03	8.9976E-04	2.7429E-04	4.2710E-03
Bridger	Hobbs Lake	2.5844E-03	4.9393E-04	1.1309E-04	2.6490E-03
Bridger	Upper Frozen Lake	5.6492E-03	9.4478E-04	2.9500E-04	4.6946E-03
Fitzpatrick	Ross Lake	2.0188E-03	4.0182E-04	4.1060E-05	7.1876E-04
Popo Agie	Pothole A-8	8.0273E-03	1.3898E-03	2.4065E-04	4.0818E-03
Mount Zirkel	Seven Lakes	3.3986E-03	5.6080E-04	1.7110E-04	3.8235E-03
Mount Zirkel	Upper Slide Lake	5.1738E-03	6.9855E-04	1.8614E-04	5.8529E-03
Medicine Bow	West Glacier	3.4947E-03	5.5870E-04	1.7520E-04	3.9599E-03
Rawah	Island Lake	6.1360E-03	1.1650E-03	2.3495E-04	6.9260E-03
Rawah	Rawah #4 Lake	3.7059E-03	7.4994E-04	1.6876E-04	4.0743E-03

Wilderness Area	Lake	S of SO <sub>2</sub> (kg S/ha-yr)	S of SO <sub>4</sub> (kg S/ha-yr)	N of NO (kg N/ha-yr)	N of HNO <sub>3</sub> (kg N/ha-yr)	Total N Dep. (kg N/ha-yr)	Total S Dep. (kg S/ha-yr)	Total N Dep. (kg N/ha-yr)
Bridger	Black Joe Lake	5.1173E-03	8.8715E-04	2.63398E-04	3.6640E-03	1.4551E-03	6.0635E-03	9.4056E-03
Bridger	Deep Lake	5.3159E-03	8.9976E-04	2.7429E-04	3.8225E-03	1.4691E-03	6.2156E-03	9.8369E-03
Bridger	Hobbs Lake	2.5844E-03	4.9393E-04	1.1309E-04	1.8513E-03	5.7267E-04	3.0783E-03	5.1860E-03
Bridger	Upper Frozen Lake	5.6492E-03	9.4478E-04	2.9500E-04	3.9173E-03	1.5040E-03	6.5940E-03	1.0411E-02
Fitzpatrick	Ross Lake	2.0188E-03	4.0182E-04	4.1060E-05	1.2320E-03	4.7893E-04	2.4206E-03	2.4708E-03
Popo Agie	Pothole A-8	8.0273E-03	1.3898E-03	2.4065E-04	3.9239E-03	1.7745E-03	9.4172E-03	1.0021E-02
Mount Zirkel	Seven Lakes	3.3986E-03	5.6080E-04	1.7110E-04	2.4567E-03	1.4081E-03	3.9594E-03	7.8594E-03
Mount Zirkel	Upper Slide Lake	5.1738E-03	6.9855E-04	1.8614E-04	3.1577E-03	1.9950E-03	5.8723E-03	1.1192E-02
Medicine Bow	West Glacier	3.4947E-03	5.5870E-04	1.7520E-04	3.4930E-03	1.4204E-03	4.0534E-03	8.0485E-03
Rawah	Island Lake	6.1360E-03	1.1650E-03	2.3495E-04	4.4911E-03	3.8030E-03	7.3010E-03	1.5455E-02
Rawah	Rawah #4 Lake	3.7059E-03	7.4994E-04	1.6876E-04	3.0464E-03	1.8409E-03	4.2273E-03	8.9274E-03

## Appendix C

### Deposition Fluxes (Acid Neutralizing Capacity and pH) at Twelve Sensitive Lake Receptors, All Sources in Domain

Wilderness Area	Lake	Inputs				Delta pH	Delta ANC (%)	Delta ANC ueq/l
		ANC (A) (ueq/l)	ppt (d) (inches)	SO <sub>2</sub> Deposition (kg/ha-yr)	NO <sub>2</sub> Deposition (kg/ha-yr)			
Bridger	Black Joe Lake	69.0	48	1.2127E-02	3.0904E-02	0.00155	0.356	0.246
Bridger	Deep Lake	61.0	48	1.2431E-02	3.2321E-02	0.00183	0.419	0.256
Bridger	Hobbs Lake	68.0	48	6.1567E-03	1.7040E-02	0.00085	0.195	0.133
Bridger	Upper Frozen Lake	5.7	48	1.3188E-02	3.4207E-02	0.02115	4.753	0.271
Fitzpatrick	Ross Lake	61.4	48	4.8412E-03	8.1182E-03	0.00052	0.119	0.073
Popo Agie	Lower Saddlebag	55.5	48	1.8834E-02	3.22926E-02	0.00229	0.527	0.292
Mount Zirkel	Pothole A-8	16.0	48	7.9189E-03	2.5824E-02	0.00529	1.211	0.194
Mount Zirkel	Seven Lakes	35.5	48	1.1745E-02	3.6773E-02	0.00342	0.785	0.279
Mount Zirkel	Upper Slide Lake	24.7	48	8.1067E-03	2.6445E-02	0.00351	0.805	0.199
Medicine Bow	West Glacier	26.1	48	1.4602E-02	5.0781E-02	0.00631	1.443	0.377
Rawah	Island Lake	64.6	48	8.4546E-03	2.9333E-02	0.00147	0.337	0.218
Rawah	Rawah #4 Lake	41.2	48	8.9117E-03	3.1948E-02	0.00249	0.572	0.236

Wilderness Area	Lake	Calculated values				
		ANC (A) (eq/l)	ppt (d) (meters)	H <sub>s</sub> (eq/m <sup>2</sup> )	H <sub>n</sub> (eq/m <sup>2</sup> )	H <sub>c</sub> (eq/m <sup>2</sup> )
Bridger	Black Joe Lake	6.90E-05	1.219	7.5793E-05	2.2394E-04	0.0000E+00
Bridger	Deep Lake	6.10E-05	1.219	7.7695E-05	2.3421E-04	0.0000E+00
Bridger	Hobbs Lake	6.80E-05	1.219	3.8479E-05	1.2348E-04	0.0000E+00
Bridger	Upper Frozen Lake	5.70E-06	1.219	8.2425E-05	2.4788E-04	0.0000E+00
Fitzpatrick	Ross Lake	6.14E-05	1.219	3.0258E-05	5.8828E-05	0.0000E+00
Popo Agie	Lower Saddlebag	5.55E-05	1.219	1.1771E-04	2.3859E-04	0.0000E+00
Mount Zirkel	Pothole A-8	1.60E-05	1.219	4.9493E-05	1.8713E-04	0.0000E+00
Mount Zirkel	Seven Lakes	3.55E-05	1.219	7.3404E-05	2.6647E-04	0.0000E+00
Mount Zirkel	Upper Slide Lake	2.47E-05	1.219	5.0667E-05	1.9163E-04	0.0000E+00
Medicine Bow	West Glacier	2.61E-05	1.219	9.1262E-05	3.6798E-04	0.0000E+00
Rawah	Island Lake	6.46E-05	1.219	5.2841E-05	2.1256E-04	0.0000E+00
Rawah	Rawah #4 Lake	4.12E-05	1.219	5.5698E-05	2.3151E-04	0.0000E+00